ARTHUR WOODWARD

THE MOST ANCIENT SKELETAL REMAINS OF MAN

BY

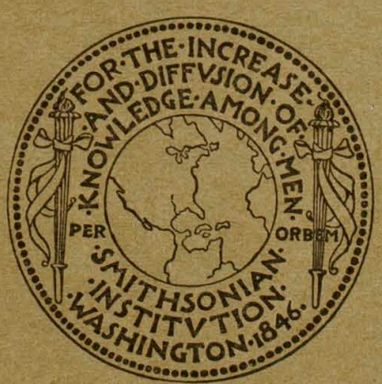
DR. A. HRDLIČKA

Curator, Division of Physical Anthropology
United States National Museum

E Call Brown

SPECIAL EDITION FOR THE PANAMA-CALIFORNIA EXPOSITION AT SAN DIEGO

[Reprinted from the Smithsonian Report, with Plates 1–41]



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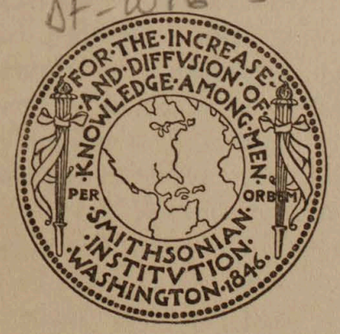

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THE MOST ANCIENT SKELETAL REMAINS OF MAN.

By Dr. A. Hrdlička,

Curator, Division of Physical Anthropology, U. S. National Museum.

[With 41 plates and 12 figures.]

Introduction.

The early history of the human race, though merged in the darkness of ages, is step by step being traced and reconstructed; and apparently the time is drawing near when science will be able to announce, in the main at least, the definite solution of the profound and involved problem of man's origin, when, in other words, it will be in a position to show, however imperfectly, when, where, and how man ascended from the lower orders.

Actual research into the antiquity of mankind began considerably less than a century ago, and the more intensive investigations in this field cover hardly a generation. Such investigations have been fraught with many difficulties and are growing in complexity. They demand patient watchfulness, diligent and long-extended exploration, and considerable expense. The most careful attention must in every case be given to geological and paleontological evidence. And, after all, the net results of a prolonged quest may be no more than a few stone chips and implements, or perhaps a tooth, or a few badly crushed bones, belonging to human antiquity. But, as there are many hands at work, invaluable materials are accumulating. Besides this every now and then the search is more richly rewarded, or some important specimen is discovered accidentally; and every new, well-authenticated addition to the remains of early man or his predecessors, more particularly if it is a part of the skeleton, means a fresh, highly valuable document which throws supplementary light on the natural history of the human being.

The explorations of recent years have been particularly fruitful. They were of wide extent geographically and have brought to science stores of primitive archeological remains, so that whole classes of ancient industries in stone could be determined; and they resulted in the recovery of example after example of well-authenticated

ancient skeletal remains representing men coeval with long-extinct animals, and with them dating far back into the Quaternary or Ice Epoch.

The aggregate of the precious skeletal material here referred to is still far from being satisfactory from the standpoint of completeness, but it is already sufficient to afford solid groundwork for important scientific deductions as to man's development; and happily exploration is going on with ever-increasing interest as well as precision. Hundreds of well-trained students are now watching and searching for new accessions with which to corroborate previous observations, to fill in the gaps, and to bring about a fuller understanding of the physical progress of man in the course of the ages.

Europe, particularly in its more western and southern portions, has thus far proved the richest in ancient human remains. Africa, Asia, and those parts of Oceanica which were formerly connected with the Asiatic continent have as yet been but little explored. The island of Java, however, which is within the last-named region, has furnished an intensely interesting specimen bearing on man's evolution and antiquity. As to America, the researches have thus far yielded nothing that could possibly be accepted as representing man of geological antiquity.[1] For the present, therefore, an account of the very ancient remains of man, with the exception of the Java specimen, must be limited to early European forms.

Such an account, in condensed form, is here presented. With the view of preparing this summary the writer, during part of the spring and summer of 1912 and under the auspices of the Smithsonian Institution, undertook a personal examination of all the more important skeletal remains relating to early man now preserved in the museums of Europe. The cultural remains were given only passing attention, partly on account of their great numbers and partly because they pertain to a collateral branch of science, prehistoric archeology, which is rapidly making them known to the world.[2] The sites of the more noteworthy discoveries were visited, however, whenever circumstances permitted.

In this communication there will be described only the very oldest of the human skeletal remains so far recovered. Besides these, the European museums possess numerous human crania and bones belonging to more recent time and therefore not of such decided general interest as the older forms, and also some whose reported age

[1] The question of Early Man in North and South America is dealt with in Bulletins 33 and 52 (published respectively in 1907 and 1912) of the Bureau of American Ethnology, Smithsonian Institution; these publications also contain the bibliography of the subject.

[2] See "Recent discoveries bearing on the antiquity of man in Europe," by G. G. MacCurdy, Smithsonian Report for 1909, Washington, 1910; the Comptes Rendus du Congrès International d'Anthropologie et d'Archéologie Préhistoriques, especially the sessions at Monaco and Geneva; also L'Anthropologie," "Man," and other anthropological periodicals.

is not generally regarded as well established. These two classes of specimens can not well be considered in this paper for it would thereby become unduly extended and possibly also involve controversy.

The questions of the antiquity and origin of man are natural subjects of the greatest interest both to the scientist and to the layman, for they touch the very foundations of human beliefs, ethics, and organic progress in the future. Their detailed solution, also, is still far from us. But it may now be safely postulated that man did not appear on our planet as an entirely new and distinct being unconnected with the rest of terrestrial organic life; for he is anatomically as well as physiologically but a highly specialized mammal that still carries numerous though now more or less useless vestiges or reminders of various lower stages through which he passed. Neither is there any good reason to regard him as the result of some freak of evolution, for his progress in the organic scale seems thoroughly logical and, judging from what has been already learned on the subject, his ascent, though probably not uniformly accelerated, was on the whole slow. We shall seemingly come nearest the truth if we look upon him as on the ultimate result of gradual modification in the upward continuity or differentiation of a highly important group of organic forms. He may be regarded as the topmost and dominating bough on an ancient mammalian tree whose roots intertwine, somewhere in the earlier Tertiary, with those of other vertebrate forms. From this tree various branches have doubtless diverged at different levels and become related species, some of these still persisting, while others have been long extinct. The stem began, so far as discernible, with lemurlike forms, from which in the course of time sprang, though scarcely in the order in which they now appear to us, the more simple and then the more highly organized primates. Among the latter then arose, it would appear, slowly or more likely rather suddenly, one or perhaps several forms characterized by more than the average physical instability; and the descendants of one or more of these strains, under the influence, in all probability, of changing environment, more especially food and climate, with perhaps other agencies, began more or less gradually to develop reduced teeth, larger brain, more erect posture, with increased facility of intercommunication; and this differentiation apparently progressed until some strain of these changing beings reached that hazy dividing line below which was still the realm of the apes but above which commenced that of the true *predecessors* of man.

The more immediate human precursors may be conceived of as forms which showed various individual advances anatomically, physiologically, and mentally toward man, as well as many morphological and other reminders of and reversions to the ape; but they

were unable to revert wholly to the latter. On the whole, they kept, probably irregularly, progressing toward man, and when eventually a part of them varied so far in the direction of the human being that a complete return even to their own former kind became impossible, then, it may be conceived, the earliest representatives of man were established. These earliest men doubtless from the beginning lacked in uniformity; some strains of them, in all likelihood, lacked also in vitality or in sufficient adaptability to changing conditions and have disappeared; but others kept on modifying in the upward direction until in the course of long ages they reached the various somewhat unequally advanced types of man of the present day.

The above deductions concerning man's origin seem to be justified from the study of the material now at the disposal of the anthropologist. The whole process of man's rise, viewed comprehensively, appears as a most remarkable, multiple, progressive, sustained, possibly more or less irregular, and not yet finished differentiation, the exact and enduring causes of which are not well understood. The various actual species of primates lower than man may in a sense be viewed as by-products of his own evolution, partly perhaps as his distant cousins, descendants from some of the old primate stocks, or as the retarded and aberrant relatives, unable or not called upon by their environment to keep up with his progress, and slowly modifying more or less sui generis. The old mono- and polygenistic theories dissolve, of course, equally before these closer assumptions.

The final stages of the progression toward the human form, according to such light on the subject as we now have, began toward the close of the Tertiary period. By the end of the Tertiary it seems probable that there already existed some of the transitional forms, the predecessors of the human being, approaching present man in size of skull and brain, in the character of the teeth, in stature, in the form of the pelvis, and in other particulars. It is even possible that before the close of this period man's precursors began the use of articulate language, and thus passed the somewhat more definite functional boundary separating these forerunners from man. But the bulk of the life history of the human being proper belongs to the Quaternary period, the period of repeated advances and retrogressions of glacial climate over the North Temperate Zone. The oldest known human remains have been found in deposits and with the bones of extinct animals of glacial or interglacial times. As we go backward into that period we find that the human forms and in general also the products of human activities become more primitive. On the other hand, after the last glacial recession, some eight thousand or more years ago, man was already physically much like he is to-day.

The time that has elapsed since the new anthropoid, or rather superanthropoid beings progressing toward man developed the physical characteristics that may be regarded as distinctively human, and acquired the faculty of speech, can not be computed in years, but the length of that period must have been many times greater than the duration of our recent or Holocene epoch, the relatively brief phase since the recession of the last ice invasion.[1]

The Oldest Well-Authenticated Skeletal Remains of Man Now Existing.

THE "PITHECANTHROPUS."

(*Pithecanthropus erectus* Dubois.)

In 1891–92 Dr. E. Dubois, then a surgeon in the Dutch Army, while engaged in paleontological excavations along the left bank of the Bengavan River, near Trinil, in the central part of the Island of Java, discovered several skeletal parts of a primate evidently higher in scale and nearer to man than any before known.

The remains were thoroughly petrified and comprised, in all, the vault of a skull, two molar teeth, and a femur.

The bones were not found simultaneously nor in the same place. They lay some distances apart, though at the same horizon and embedded in the same stratum of volcanic matrix. This stratum was rich in fossil remains of various organic forms and, in the locality where the excavations were carried on, was about 1 meter below the dry-season water level, or 12 to 15 meters below the plain in which the river had cut its bed.

In September, 1891, the excavations in the volcanic matrix yielded unexpectedly, among other fossils, a remarkable tooth, a molar, which was determined as having belonged to a large unknown primate. A month later the unique and most interesting skull cap was discovered, only 1 meter distant from the place where lay the tooth. It now became certain that traces had come to light of a hitherto unknown primate of large size, standing in many respects nearer to man than any of the actual anthropoid apes. It was seemingly an intermediate form between the apes and man, and was characterized by the name of "*pithecanthropus.*"

Then came the rainy season and work had to be suspended. Exploration was recommenced, however, as early as possible in 1892, and in August of that year the femur was found about 15 meters (50 feet) from the locality where the other specimens had been em-

[1] For the duration and subdivision of the Glacial Epoch the following works may be consulted: T. E. Chamberlin and R. D. Salisbury's Geology, 1906; Osborn, H. F., The age of mammals in Europe, Asia, and North America; H. Obermaier, Der Mensch der Vorzeit, 8°, Berlin, 1912; and R. R. Schmidt, E. Koken and A. Schliz, Die Diluviale Vorzeit Deutschlands, 4°, Stuttgart, 1912. These works give further bibliography.

bedded. Finally, in October of the same year, the second molar was secured, at a distance of not more than 3 meters (13 feet) from the original position of the skull cap, and in the direction of the resting place of the femur.

The accompanying illustrations (pl.[1] and text fig. 1) show the locality of the discovery and the approximate positions of the specimens.

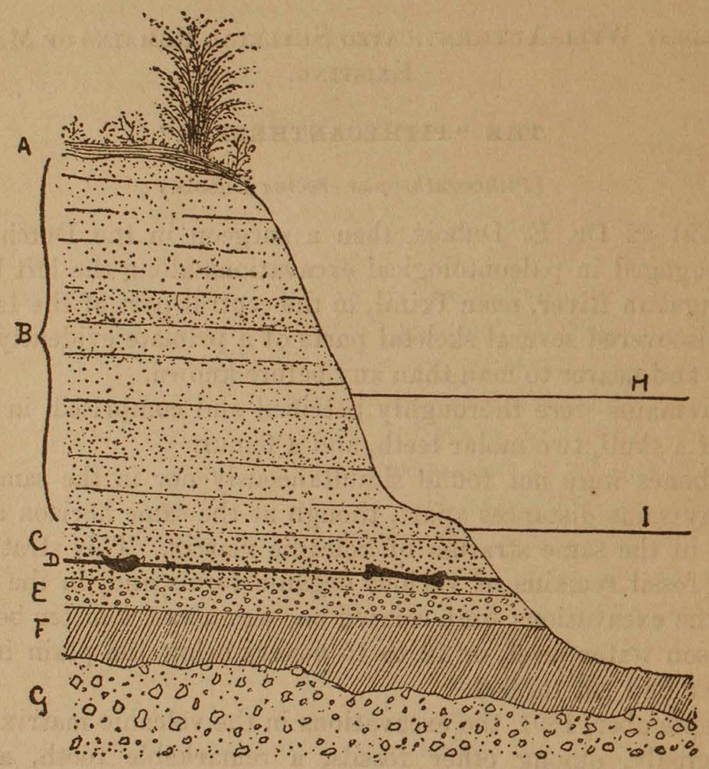


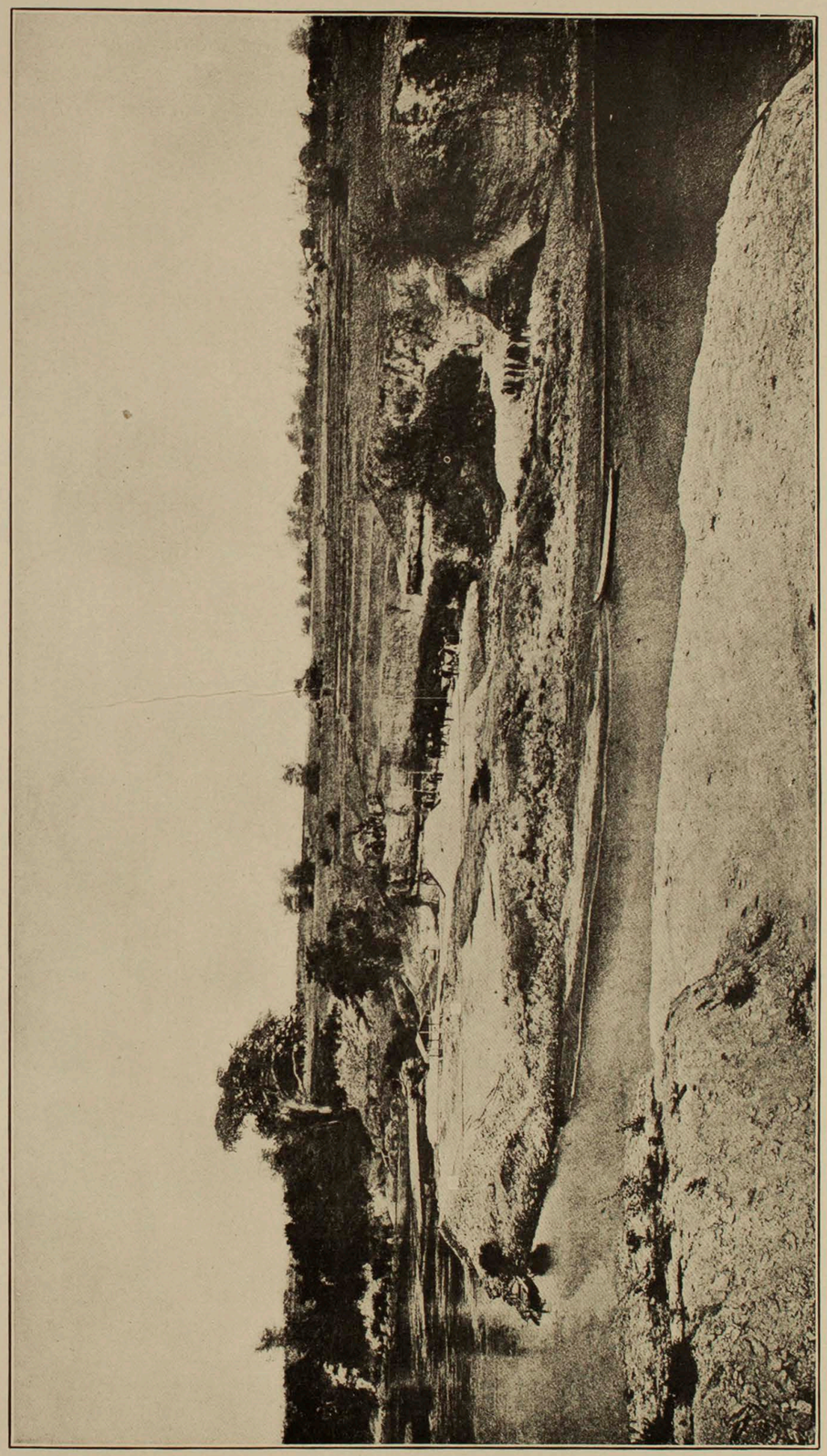
FIG. 1.—SECTION OF THE OSSIFEROUS STRATA AT THE LOCALITY WHERE THE PITHECANTHROPUS BONES WERE DISCOVERED. A, AREA OF GROWING PLANTS; B, SOFT SANDSTONE; C, LAPILLI STRATUM; D, LEVEL AT WHICH THE SKELETAL REMAINS WERE FOUND; E, CONGLOMERATE; F, ARGILLACEOUS LAYER; G, MARINE BRECCIA; H, WET-SEASON LEVEL OF THE RIVER; I, DRY-SEASON LEVEL OF THE RIVER. (After Dubois, Smithsonian Report for 1898.)[2]

All four specimens were considerably mineralized, being of chocolate-brown color, very heavy, and "harder than marble." Numerous bones of mammals found in the same bed belonged to species now extinct or, so far as known, not now living in Java, and showed fossilization similar to that of the bones of the Pithecanthropus. The contours of the teeth and the femur were sharp, indicating that

[1] After Mme. L. Selenka and M. Blankenhorn: Die Pithecanthropus-Schichten auf Java, 4°, Leipzig, 1911.

[2] From the Smithsonian Report for 1898, p. 446, article Pithecanthropus erectus, by Eugène Dubois (translated from the Anatomischer Anzeiger, vol. 12, pp. 1–22); original in Trans. Royal Dublin Soc., vol. 6, 1896, pp. 1–18.

PLATE 1.



THE LOCALITY OF THE PITHECANTHROPUS FIND, ON THE BENGAVAN RIVER, NEAR TRINIL, JAVA (AFTER MME. SELENKA AND M. BLANKENHORN).
The two white squares show where the femur (on left) and the skullcap (on right and more behind) were discovered.

Smithsonian Report, 1913.—Hrdlička.

it has not been washed or rolled about to any great extent; but the skull cap showed the effects of erosion, probably caused by acidulous water seeping through the deposits.

All indications and a detailed study of the specimens led Dubois to the conclusions that: (1) The four skeletal pieces in question were contemporaneous; (2) they were of the age of the stratum in which found; (3) they belonged to one skeleton; and (4) they represent a transitional form of beings between the anthropoid apes and man, belonging to the direct line in the genealogy of the latter.

The first published announcement of the discovery by Dubois appeared in 1894;[1] to-day the subject possesses already a relatively large literature of its own.[2] A special expedition of two years' duration has also since worked on the site of the discovery,[3] and the remains are regarded universally as of the greatest scientific value; but the final word concerning their exact age and true biological position has not yet been pronounced.

It should be stated at once that there is no room for doubt as to the place of discovery of the several bones and their geological or paleontological relations. The several pieces were found in situ, in the progress of scientific exploration, by a careful and competent observer. But the precise age of the stratum in which they lay, and their exact biological position among related forms, are not yet absolutely delimited. While Dubois and other scientific men regard the Pithecanthropus remains as all belonging to the same skeleton, as dating chronologically from the latest part of the Tertiary or the earliest phase of the Quaternary period, and as representing a true intermediary form between the anthropoid apes and man, others have expressed doubts as to whether the four bones belong to the

[1] Pithecanthropus erectus. Eine menschenähnliche Üebergangsform aus Java. Von Eug. Dubois, Militärarzt der Niederländischen Armee. Mitt zwei Tafeln und drei in den Text gedruckten Figuren., 4°, Batavia, 1894.

[2] Few of the more important English contributions to the subject are:

Marsh, O. C. On the Pithecanthropus erectus Dubois, from Java. (Amer. Journ. Sci., Feb. 1895.) On the Pithecanthropus erectus, from the Tertiary of Java. (Ibid., 4th ser., vol. 1, 1896, pp. 475–482.)

Turner, William. On M. Dubois's description of remains recently found in Java, named by him Pithecanthropus erectus, with remarks on the so-called transitional forms between Apes and Man. (Journ. Anat. and Physiol., vol. 29, 1895, pp. 424–445.)

Dubois, E. On Pithecanthropus erectus: a transitional form between man and the apes. (Journ. Anthrop. Instit. Great Britain and Ireland, Feb. 1896, pp. 240–255; Trans. Royal Dublin Soc., ser. 2, vol. 6, Dublin, 1898, pp. 1–18; Smithsonian Report for 1898 (Washington, 1899), pp. 445–459.)

Manouvrier, L. On Pithecanthropus erectus. Transl. by G. G. MacCurdy. (Amer. Journ. Sci., 4th ser., vol. 4, Sept. 1897, pp. 213–234.)

Hepburn, David. The Trinil femur (Pithecanthropus erectus) contrasted with the femora of various savage and civilized races. (Rep. 66th meeting Brit. Assoc. Adv. Sci., 1897, pp. 926–927.)

For literature in other languages see especially G. Schwalbe, Studien ü. Pithecanthropus erectus Dubois. (Zeitschr. f. Morphologie und Anthropologie, Bd. 1, Stuttgart, 1899, pp. 1–240, bibliogr. 234–240.)

[3] Under Mme. Selenka; see "Die Pithecanthropus-Schichten auf Java," by Mme. Lenore Selenka and M. Blankenhorn, 4°, Leipzig, 1911.

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same form; or they consider the age of the remains, though no doubt early Quaternary, to be less than that estimated by Dubois; and finally some incline to regard the remains as those of early man rather than an intermediary being, while still others consider that they represent merely a superior extinct form of ape.[1]

BRIEF DESCRIPTION OF THE SPECIMENS.

(Plates 2, 3, text fig. 2.)

On account of peculiar circumstances an attempt to describe first hand the important pieces under consideration meets with serious difficulties. It would surely seem proper and desirable that specimens of such value to science should be freely accessible to well-qualified investigators and that accurate casts be made available to scientific institutions, particularly after 20 years have elapsed since the discovery of the originals. Regrettably, however, all that has thus far been furnished to the scientific world is a cast of the skull cap, the commercial replicas of which yield measurements different from those reported taken of the original, and several not thoroughly satisfactory illustrations; no reproductions can be had of the femur and the teeth, and not only the study but even a view of the originals, which are still in the care of their discoverer, are denied to scientific men. Under these anomalous conditions it is only possible to follow Dr. Dubois's old information.[2]

The skull cap (pl. 2) measures in greatest length 18.5 (on cast 18.1) cm., in greatest (parietal) breadth 13 (on cast 13.3) cm., and at the minimum of the frontal constriction 8.7 cm.[3] It is dolichocephalic, its outline as seen from above is oblongly ovoid, narrowing considerably forward, and it is very low. It presents excessively prominent though not massive supraorbital arch and a very sloping front. The frontal bone, in addition, shows externally and along its middle a well-defined ridge, running from a short distance above the glabella toward bregma, and a marked low protuberance just forward of the bregma. The sagittal region is relatively flat and smooth, and the occiput presents a dull transverse crest, connecting as in apes, though in much less pronounced manner, with the supramastoid crest on each side.

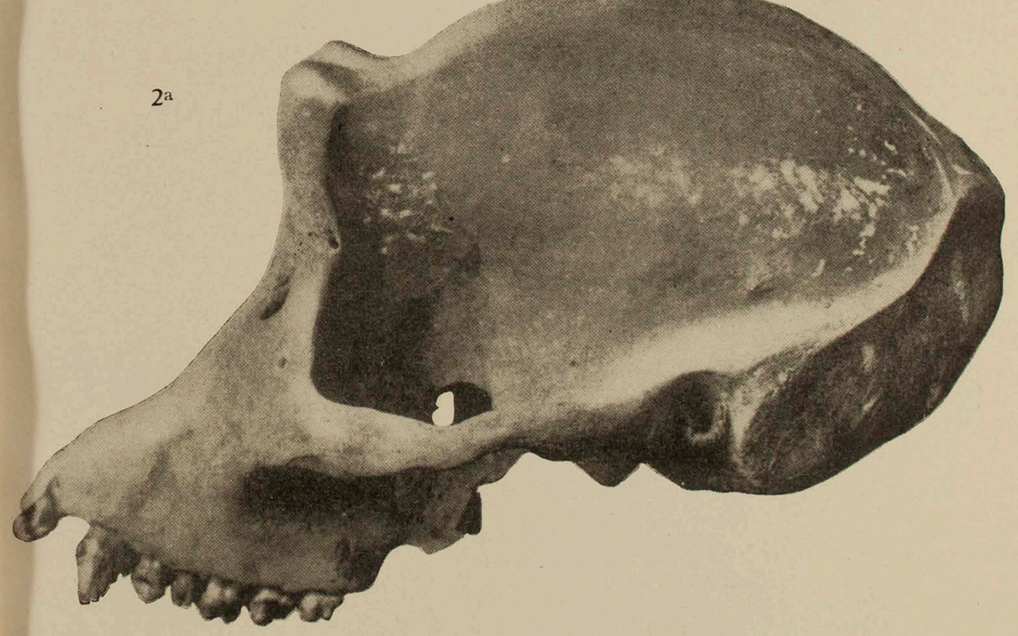
[1] For numerous of the earlier phases of these controversies see Dubois's paper in the Transactions of the Royal Dublin Society; also that in the Smithsonian Report for 1898, p. 449 et seq.

[2] The extended and meritorious work on the skull by Schwalbe (op. cit.) was made on a cast, which evidently was in all respects identical with the one in the U. S. National Museum, but the measurements on which do not exactly agree with those given by Dubois on the original. These differences, however unfortunate, do not, of course, in any way detract from the importance of the original.

[3] For comparison it may be stated that similar measurements on an ordinary white male American dolichocephalic cranium give approximately 19.1, 14.3, and 10 centimeters; on female, 18.3, 13.7, and 9.6 centimeters.

1a

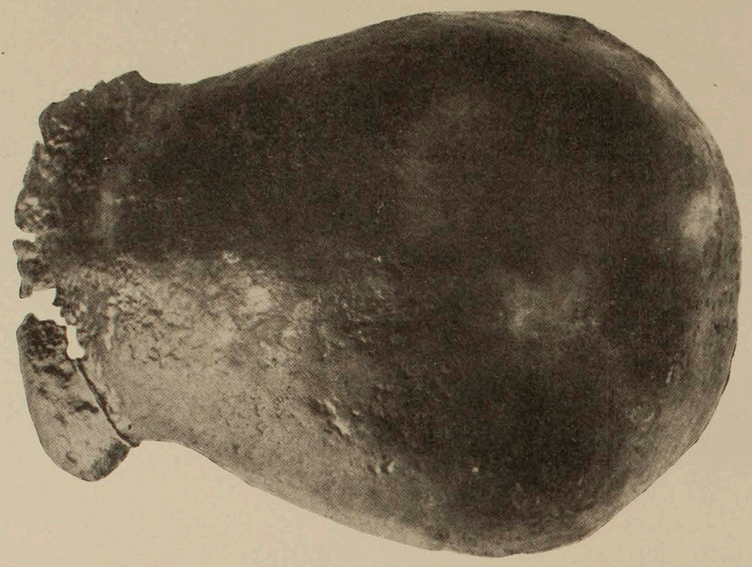
2a



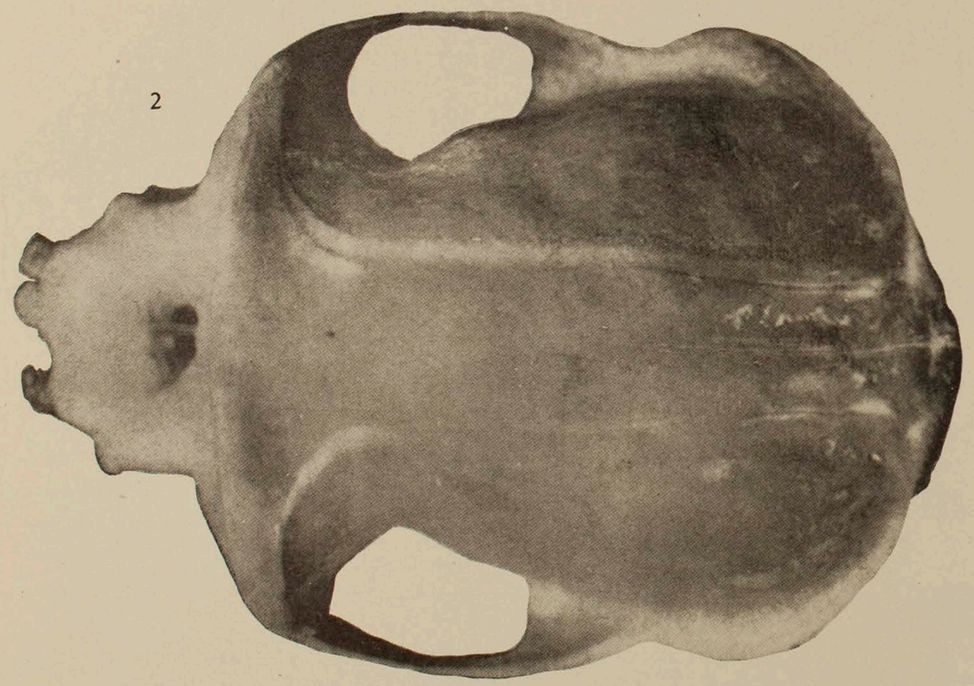
1a. PITHECANTHROPUS ERECTUS, SKULLCAP, FROM LEFT SIDE (ONE-HALF NATURAL SIZE).
2a. ANTHROPOPITHECUS TROGLODYTES, ADULT FEMALE SKULL, FROM LEFT SIDE (TWO-THIRDS NATURAL SIZE).

(After Dubois, Smithsonian Report for 1898.)

1



2



(1.) PITHECANTHROPUS ERECTUS, SKULLCAP, FROM ABOVE (ONE-HALF NATURAL SIZE).
(2.) ANTHROPOPITHECUS TROGLODYTES, ADULT FEMALE SKULL, FROM ABOVE (TWO-THIRDS NATURAL SIZE).

(After Dubois, Smithsonian Report for 1898.)

Without going into a detailed discussion of these characteristics, it will suffice to say that in most respects the specimen differs more or less from the ordinary human skull of to-day as well as from those of early man, so far as known, and approaches correspondingly the crania of the anthropoid apes.

The temporal ridges, marking on the parieties of the vault the upper limit of the temporal muscles and fascia, are well defined but run rather distant (about 4 cm. on each side) from the median line, as in female anthropoids and in man. This suggests that the cranium

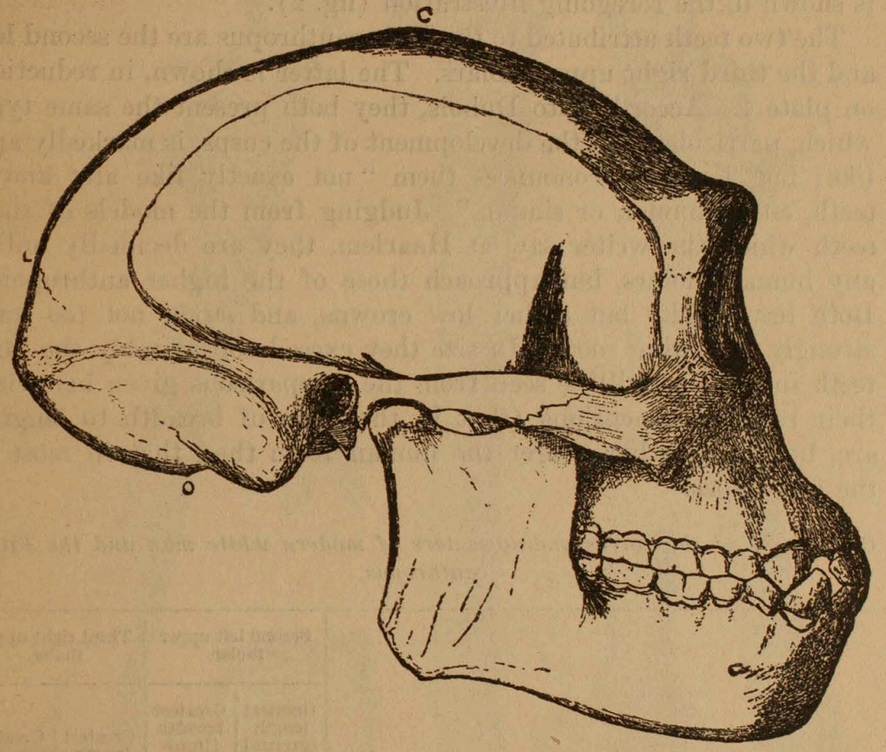


FIG. 2.—ATTEMPT AT A RESTORATION OF THE SKULL OF THE PITHECANTHROPUS ERECTUS HALF THE NATURAL SIZE. (After Dubois, Smithsonian Report for 1898.)

may be feminine. The whole remnant, in fact, presents rather subdued forms, such as would more readily be expected in a female than in a male being at that stage of evolution.

The walls of the skull are of only moderate thickness. Its internal capacity was originally believed by Dubois to have been quite large, namely about 1,000 c. c., but eventually he reduced this estimate to 900 c. c. or a little over. The capacity of an average cranium of a white American would amount in the male to about 1,500, in the female to about 1,350 c. c., while in the largest living anthropoid apes it only rarely attains or exceeds 600 c. c.

The impression which a comprehensive study of the whole skull cap carries to the observer is, that it represents a hitherto unknown primate form, which, whatever it may eventually be identified with and whether or not man's direct ancestor, stands morphologically between man and the known anthropoid apes, fills an important space in the hitherto existing large void between the two, and constitutes a precious document for the natural history of man.

Dubois's theoretical restoration of the whole cranium of the Pithecanthropus, which in all probability comes fairly near to the reality, is shown in the foregoing illustration (fig. 2).

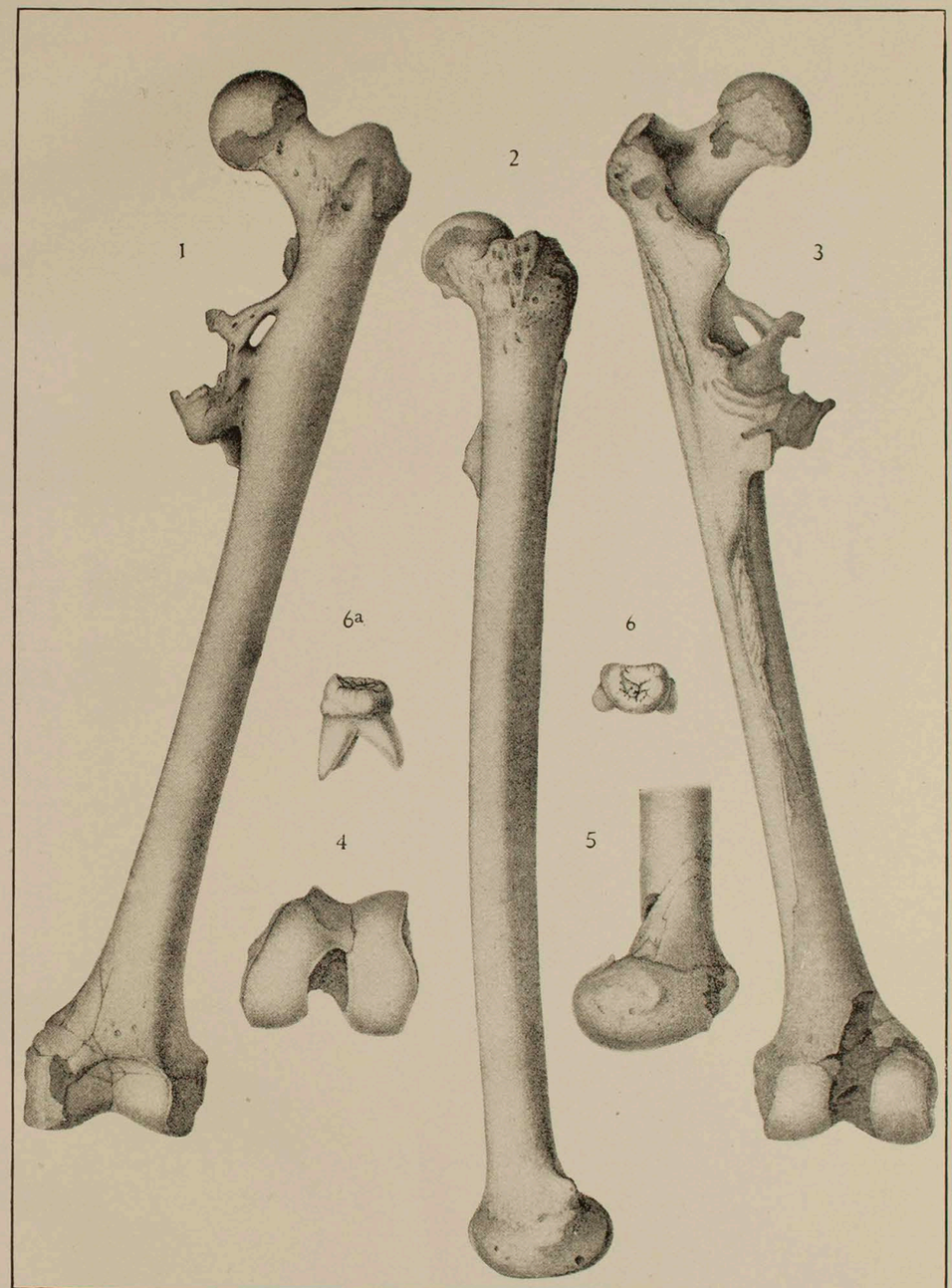
The two teeth attributed to the Pithecanthropus are the second left and the third right upper molars. The latter is shown, in reduction, on plate 4. According to Dubois, they both present the same type, which, particularly in the development of the cusps, is markedly ape-like; but Tomes[1] pronounces them "not exactly like any known teeth, either human or simian." Judging from the models of these teeth which the writer saw at Haarlem, they are decidedly unlike any human molars, but approach those of the higher anthropoids. Both have bulky but rather low crowns, and stout, not too long, strongly diverging roots. In size they exceed considerably the same teeth in man, as will be seen from the comparisons given herewith; their relative dimensions (that is, the ratio of breadth to length) are, however, rather nearer the human form than that in most of the large apes.

Comparison of the corresponding molars of modern white man and the Pithecanthropus.

	Second left upper molar.		Third right upper molar.	
	Greatest length (sagittal diameter).	Greatest breadth (transverse diameter).	Greatest length.	Greatest breadth.
	mm.	*mm.*	*mm.*	*mm.*
Average white man, approximate	9.5	11.0	9.0	10.5
Pithecanthropus	12.0	14.0	11.3	15.3

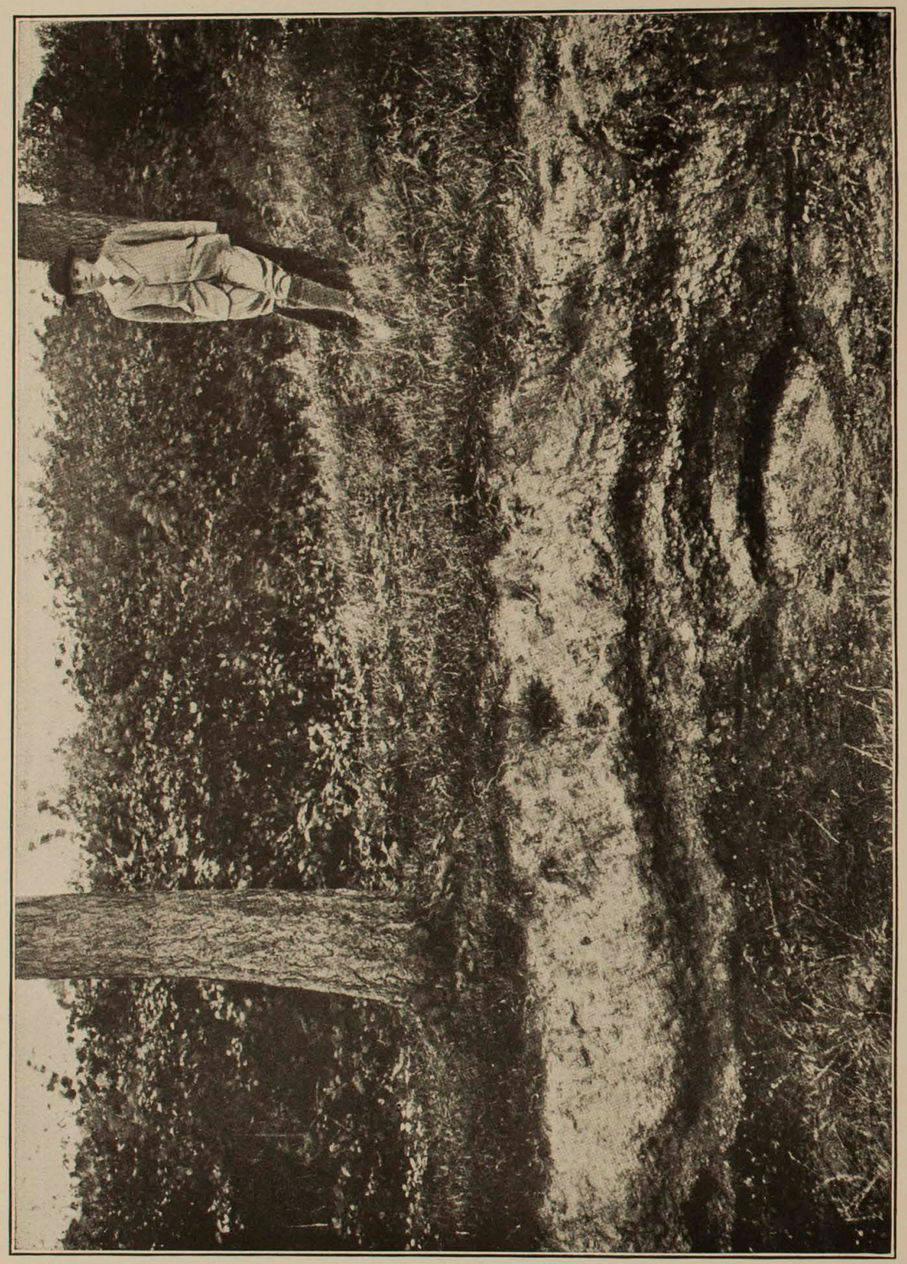
On the whole, it seems evident that the two teeth represent a higher primate form; in all probability they come from one individual, and their morphological characteristics are such that they may well have belonged to the same species or even the same individual as the before-described skullcap. Their size, as seen from a comparison with the teeth of larger existing anthropoid apes, is not incompatible with the size of the skullcap, and that even if the latter belonged to a female individual.

[1] Dental anatomy, 8°, London, 1904, p. 560.



PITHECANTHROPUS ERECTUS.

Left femur: 1, from before; 2, from side; 3, from behind; 4, from below; 5, lower end from median side; 6, right third upper molar, from below; 6a, from behind. (Reduced, after Dubois, from Smithsonian Report for 1898.)



The Gravel Bed at Piltdown, from the Darkest Stratum of which, Resting on the Bedrock, the Fossil Human Skull and Jaw were Obtained.
(After Charles Dawson.)

Smithsonian Report, 1913.—Hrdlička.

The Trinil femur (pl. 4), according to Dubois, Manouvrier, and others, bears a close resemblance to the human thigh bone, both in size and shape; nevertheless judging from the illustration it presents also some important differences. Its length, 45.5 cm., equals that of a human femur from a man 1.70 meters (5 feet, 7 inches) in stature, and of proportionate strength.[1] Notwithstanding these dimensions, however, the relatively large inclination of the bone from the vertical when stood up on its condyles, and the relatively moderate-sized head and lower articular extremity, suggest that, as was the case with the skullcap, the bone may proceed from a female.

The femur plainly belonged to a strong being maintaining erect or near-erect posture and marching mostly or entirely biped, as man.

The principal differences of the bone from a modern human femur consist in its less-marked antero-posterior curve, in a more evenly cylindrical shaft, in the more mesial position of the smaller trochanter, in the intertrochanteric line being less raised and hence more simian in character, and in the popliteal space which, as a rule concave from side to side in present man, is convex in the Trinil specimen.

THE "EOANTHROPUS DAWSONI."

A somewhat problematical as yet but deeply interesting find of ancient human skeletal remains has recently come to light in England. The specimen representing this discovery is an imperfect cranium, with a part of the lower jaw and a canine tooth. It is known as the Sussex or Piltdown skull, or more technically as the *Eoanthropus Dawsoni*, and its preservation is due to Mr. Charles Dawson. It is deposited in the British Museum of Natural History at Kensington and was first reported, with the circumstances of the find, on December 18, 1912, before the London Geological Society.[2]

The history of this specimen, as given by Mr. Dawson, illustrates the usefulness and need, especially in the Old World, of scientific supervision of excavations. Mr. Dawson's statement is as follows:[3]

> Several years ago I was walking along a farm road close to Piltdown Common, Fletching (Sussex), when I noticed that the road had been mended with some peculiar brown flints not usual in the district. On inquiry I was astonished to learn that they were dug from a gravel bed on the farm, and shortly

[1] The circumference of the shaft at middle is 9 cm., or one-fifth of the length of the bone, which proportion is often equaled in present man; the breadth at middle is 2.75 cm. Numerous other measurements of the bone are given in Dubois's "Pithecanthropus erectus," etc., 4°, Batavia, 1894, p. 21, et seq.

[2] Dawson, Charles, A. Smith Woodward, and G. Elliot Smith. On the discovery of a Palaeolithic skull and mandible in a flint-bearing gravel overlying the Wealden (Hastings beds) at Piltdown, Fletching (Sussex). (Quart. Journ. Geol. Soc. for March, 1913, vol. 69, pp. 117–144.) See also Haddon, A. C., Eoanthropus Dawsoni (Science, Jan. 17, 1913, pp. 91–92); and MacCurdy, G. G., Ancestor hunting: The significance of the Piltdown skull (Amer. Anthropologist, vol. 15, 1913, pp. 248–256).

[3] L. c., p. 117 et seq.

afterwards I visited the place, where two laborers were at work digging the gravel for small repairs to the roads. As this excavation was situated about four miles north of the limit where the occurrence of flints overlying the Wealden strata is recorded I was much interested and made a close examination of the bed. I asked the workmen if they had found bones or other fossils there. As they did not appear to have noticed anything of the sort I urged them to preserve anything that they might find. Upon one of my subsequent visits to the pit, one of the men handed to me a small portion of an unusually thick human parietal bone. I immediately made a search, but could find nothing more nor had the men noticed anything else. The bed is full of tabular pieces of ironstone closely resembling this piece of skull in color and thickness; and, although I made many subsequent searches, I could not hear of any further find nor discover anything—in fact, the bed seemed to be quite unfossiliferous.

It was not until some years later, in the autumn of 1911, on a visit to the spot, that I picked up, among the rain-washed spoil heaps of the gravel pit, another and larger piece belonging to the frontal region of the same skull, including a portion of the left superciliary ridge * * *.

I took the bones to Dr. A. Smith Woodward at the British Museum (Natural History) for comparison and determination. He was immediately impressed with the importance of the discovery, and we decided to employ labor, and to make a systematic search among the spoil heaps and gravel as soon as the floods had abated, for the gravel pit is more or less under water during five or six months of the year. We accordingly gave up as much time as we could spare since last spring (1912) and completely turned over and sifted what spoil material remained; we also dug up and sifted such portions of the gravel as had been left undisturbed by the workmen * * *.

At Piltdown the gravel bed occurs beneath a few inches of the surface soil and varies in thickness from 3 to 5 feet * * *.

Portions of the bed are rather finely stratified, and the materials are usually cemented together by iron oxide, so that a pick is often needed to dislodge portions—more especially at one particular horizon near the base. It is in this last mentioned stratum that all the fossil bones and teeth discovered in situ by us have occurred. The stratum is easily distinguished in the appended photograph (pl. 5) by being of the darkest shade and just above the bedrock.

The gravel is situated on a well-defined plateau of large area * * * and lies about 80 feet above the level of the main stream of the Ouse.

Since the deposition of the gravel the river has cut through the plateau, both with its main stream and its principal branch, to this extent.

Considering the amount of material excavated and sifted by us, the specimens discovered were numerically small and localized.

Apparently the whole or greater portion of the human skull had been shattered by the workmen, who had thrown away the pieces unnoticed. Of these we recovered from the spoil heaps as many fragments as possible. In a somewhat deeper depression of the undisturbed gravel I found the right half of a human mandible. So far as I could judge, guiding myself by the position of a tree 3 or 4 yards away, the spot was identical with that upon which the men were at work when the first portion of the cranium was found several years ago. Dr. Woodward also dug up a small portion of the occipital bone of the skull from within a yard of the point where the jaw was discovered and at precisely the same level. The jaw appeared to have been broken at the symphysis and abraded, perhaps when it lay fixed in the gravel and before its complete deposition. The fragments of cranium show little or no sign of rolling or other abrasion, save an incision at the back of the parietal, probably caused by a workman's pick.

A small fragment of the skull has been weighed and tested by Mr. S. A. Woodhead, M. Sc., F. I. C., public analyst for East Sussex and Hove, and agricultural analyst for East Sussex. He reports that the specific gravity of the bone (powdered) is 2.115 (water at 5° C. as standard). No gelatine or organic matter is present. There is a large proportion of phosphates (originally present in the bone) and a considerable proportion of iron. Silica is absent.

Besides the human remains, we found two small broken pieces of a molar tooth of a rather early Pliocene type of elephant, also a much-rolled cusp of a molar of *Mastodon*, portions of two teeth of *Hippopotamus*, and two molar teeth of a Pleistocene beaver. In the adjacent field to the west, on the surface close to the hedge dividing it from the gravel bed, we found portions of a red deer's antler and the tooth of a Pleistocene horse. These may have been thrown away by the workmen, or may have been turned up by a plough which traversed the upper strata of the continuation of this gravel bed. Among the fragments of bone found in the spoil heaps occurred part of a deer's metatarsal, split longitudinally. This bone bears upon its surface certain small cuts and scratches which appear to have been made by man. All the specimens are highly mineralized with iron oxide. * * *

Among the flints we found several undoubted flint implements, besides numerous Eoliths. * * *

From the above Mr. Dawson believed himself justified in drawing the following conclusions:

It is clear that this stratified gravel at Piltdown is of Pleistocene age, but that it contains in its lowest stratum animal remains derived from some destroyed Pliocene deposit probably situated not far away and consisting of worn and broken fragments. These were mixed with fragments of early Pleistocene mammalia in a better state of preservation, and both forms were associated with the human skull and mandible, which show no more wear and tear than they might have received in situ. Associated with these animal remains are Eoliths, both in a rolled and an unrolled condition; the former are doubtless derived from an older drift, and the latter in their present form are of the age of the existing deposit. In the same bed, in only a very slightly higher stratum, occurred a flint implement, the workmanship of which resembles that of implements found at Chelles, and among the spoils heaps were found others of a similar, though perhaps earlier, stage.

From these facts it appears probable that the skull and mandible can not safely be described as being of earlier date than the first half of the Pleistocene (or Glacial) epoch. The individual probably lived during a warm cycle of that age.

The anthropological report on the specimen by Dr. Woodward brings forth the following main details:

The human remains comprise the greater part of a brain case and one ramus of the mandible, with lower molars 1 and 2. All the bones are normal, with no traces of disease, and they have not been distorted during mineralization.

Of the brain case there are four pieces (reconstructed from nine fragments) sufficiently well preserved to exhibit the shape and natural relations of a larger part of the vault and to justify the recon-

struction of some other features. These bones are particularly noteworthy for their thickness, which reaches 20 mm. at the internal occipital protuberance and 10 mm. along the greater part of the fractured edges of the frontal and parietals. The average thickness of modern European skulls, except in the locality of the various ridges and sutures, varies between 4 and 6 mm.

The greater portion of the brain case may be reconstructed without any hypothetical restoration, the only serious deficiency being the middle portion of the frontal region above and including the larger portion of the supraorbital ridge. Such a reconstruction, with a justifiable amount of modeling, has been skillfully made by Mr. Frank O. Barlow in the Palaeontological Laboratory of the British Museum. * * * It is shown in plate 6.

The reconstructed cranium (pl. 6) is evidently that of an adult, but not old, female. Seen from above, it shows a short ovoid outline. It is wide posteriorly, measuring 15.0 cm. across its widest part, just behind the zygomatic arch, and tapering moderately forward to a slight constriction behind the supraorbital ridge, where its width (the diameter frontal minimum) is 11.2 cm. The total length from the middle of the supraorbital ridge (glabella) to the external occipital protuberance (inion) is uncertain, owing to the hypothetical restoration of the frontals, but it measured probably not far from 19.0 cm. The cephalic index may have been, therefore, somewhere about 78 or 79.

In anterior view the relative narrowness of the frontal region is well shown, and the vault is seen to rise to the vertex at the widest part of the skull. In side view this upward slope is still better seen, and the steeply curved frontal contour is especially noteworthy. The external occipital protuberance (inion) seems to form the hindmost point of the cranium, though the portion of the occipital immediately above it is in an almost vertical plane.

In back view the contour of the skull is very remarkable. It is relatively low and wide, and gently arched above, with the sides flattened in their upper half, and the mastoid region either vertical or slightly inclined inward. * * *

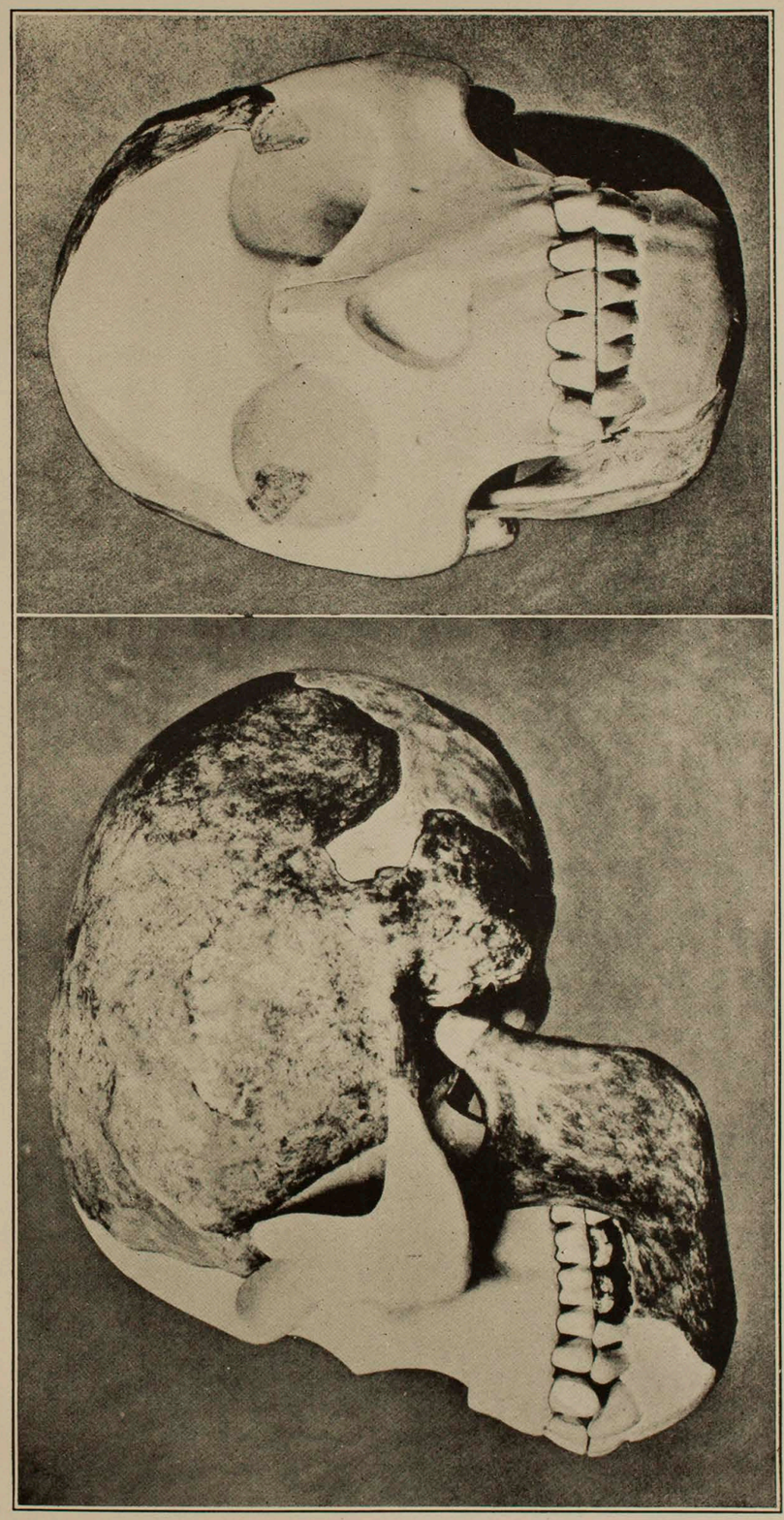
A detailed examination of the several bones of the skull is interesting, as proving the typically human character of nearly all the features that they exhibit. The only noteworthy reminiscences of the ape are met with in the upward extension of the temporal fossæ and in the low and broad shape of the occiptial region. The frontal region, which is complete on the left side and in its upper middle portions, shows a fairly developed forehead, with well-rounded frontal eminence. Judging from the remainder of the supraorbital border, it is clear that there can not have been any prominent or thickened supraorbital ridge, and in consequence of this the missing parts of the frontal region were restored on the plan of an ordinary human skull—

which was, perhaps, not fully justifiable.

The temporal crest is sharply developed over the frontal and parietals.

Immediately behind the middle of the coronal suture the parietal region is distinctly flattened; but as it expands backward, the roof soon rises to a broad rounded vertex. The parietal eminences are conspicuous. The nearest ap-

PLATE 6.



FIRST RESTORATION OF THE SKULL AND MANDIBLE OF EOANTHROPUS DAWSONI.
(After Dawson and Woodward.)

Smithsonian Report, 1913.—Hrdlička.

proach of the upper line of the temporal crest to the sagittal suture is 36 mm., a distance frequently equaled in the present man. The parietal suture is completely obliterated, but the lambdoid is open and parts of it show well-developed serration. The squamous suture is well arched, as in the typical modern human skull.

The occipital bone is remarkable both for its relatively great width, and for the large area and flattenings of its smooth upper portion. The external occipital protuberance and the muscular ridges are well marked.

The left temporal bone, which is excellently preserved, is "typically human in every detail," and corresponds closely with the same bone in a comparatively modern human skull. The mastoid is rather small.

The capacity of the brain-case can not, of course, be exactly determined; but measurements both by millet-seed and by water show that it must have been at least 1,070 cc., while a consideration of the missing parts suggests that it may have been a little more. It therefore agrees closely with the capacity of the brain-case of the Gibraltar skull, as determined by Prof. Keith, and equals that of some of the lowest skulls of the existing Australians. It is much below that of the Mousterian skulls from Spy and La Chapelle-aux-Saints.

The intercranial cast shows, according to Elliot Smith, "a considerable resemblance to the well-known palaeolithic brain-casts, and especially to those obtained from the Gibraltar and La Quina remains. * * * Like these it is relatively long, narrow, and especially flat; but it is smaller and presents more primitive features than any known human brain or cranial cast." Marked peculiarities of conformation are shown particularly in the parietal and temporal region. The length of the left cerebral hemisphere was only 16.3 cm., due to the thickness of the bones, while the maximum breadth of the brain (located lower down than usual), was 13.0 cm., the maximum height 10.6 cm.[1] The author concludes that "taking all its features into consideration, we must regard this as being the most primitive and most simian human brain so far recorded; one, moreover, such as might reasonably have been expected to be associated in one and the same individual with the mandible, which so definitely indicates the zoological rank of its original possessor."

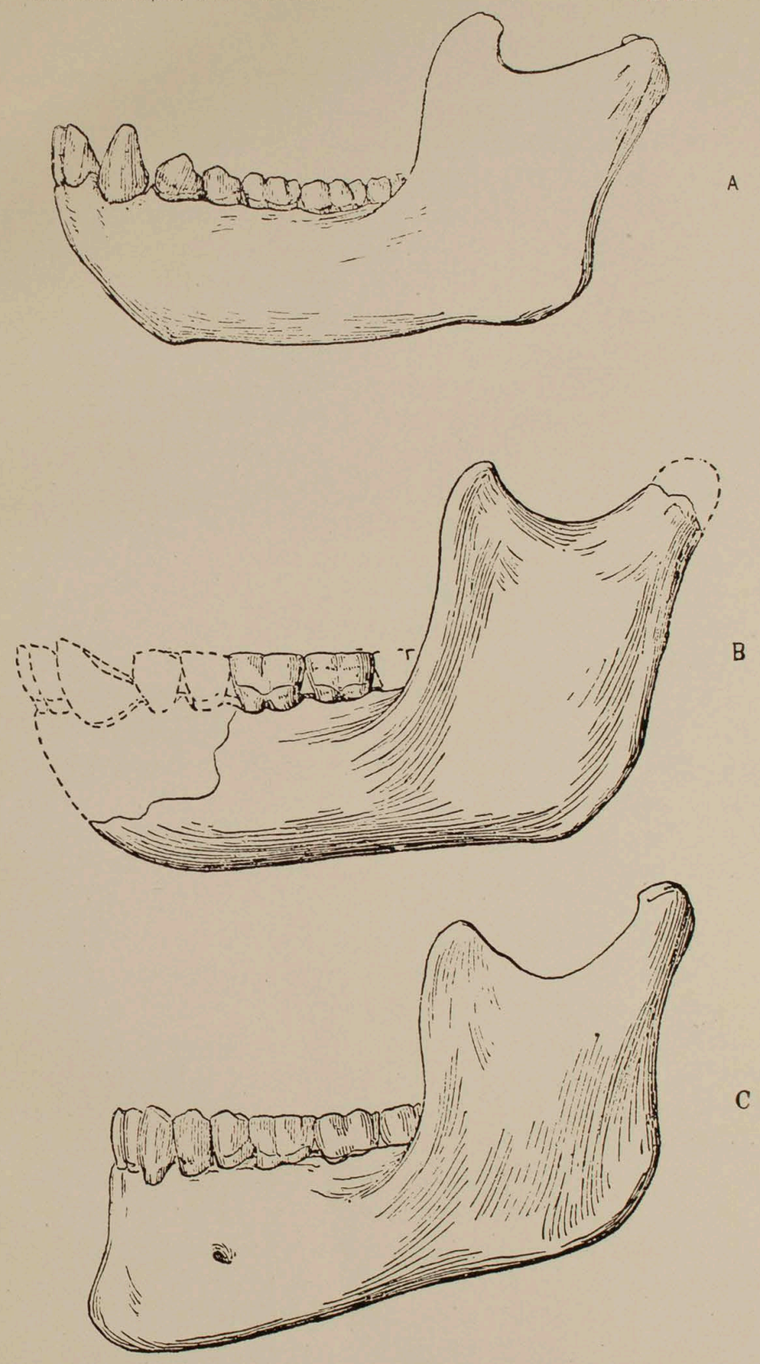
As regards the lower jaw and the teeth it will be best to quote again from Dr. Woodward. According to this observer: "While the skull, indeed, is evidently human, only approaching a lower grade in certain characters of the brain in the attachment for the neck, the extent of the temporal muscles and in the probably large size of the

[1] The brain of a white male from Ireland, whose skull possessed very nearly the same external measurements (length 19 cm., breadth 14.9 cm.), gave the writer 17 cm. in length, 13.8 cm. in breadth, and 11.8 cm. in height.

face, the mandible appears to be almost precisely that of an ape, with nothing human except the molar teeth * * *." What there is of the lower jaw shows the same mineralized condition as the skull, and the specimen "corresponds sufficiently well in size to be referred to the same individual without any hesitation." It is fairly well preserved. "It lacks the condyle and a larger part of the symphysis with most of the dental arch, but retains the first two molars, as well as the socket for the third. The ascending ramus is relatively broad. The bone is massive and its outer surface is deeply marked with irregular hollows for the insertion of a powerful masseter muscle. The horizontal ramus measures only about 27 mm. in height behind, but must have been a little higher forward. There is a great width of the temporal insertion, the mylohyoid groove is situated behind rather than in line with the dental foramen, and there is a complete absence of the mylohyoid ridge—all characters of the mandible in apes, not in man. As the horizontal ramus curves round to the symphysis its lower margin exhibits an increasingly wider flattening, which begins beneath the second molar, slopes upward and outward, and ends in front in the strongly retreating chin. The inner edge of this flattening is sharply rounded, and at the symphysis itself the inner face of the jaw is so much depressed in its lower part that the bone here has the form of a nearly horizontal plate or flange, closely similar to that found in all the apes. The genio-hyo-glossal and genio-hyoid muscles, in fact, must have had their origin in a deep pit, as in the apes; while the digastric can only have been inserted on the edge of the bony flange instead of extending far over the lower border as in man. Unfortunately, the absence of the upper part of the symphysis does not allow of a precise restoration of the specimen. As, however, the whole of the bone preserved closely resembles that of a young chimpanzee, it seemed reasonable to restore the fossil on this model and make the slope of the bony chin intermediate between that of the adult ape and that of *Homo heidelbergensis* (pl. 7). If this restoration proved to be correct then the alveolar border was so long that it would be necessary to assume the presence of a relatively large, though probably not very prominent canine. The two molar teeth are noteworthy for their considerable length in proportion to their width and in each being provided with a large fifth cusp. They are, although distinctly human, of the most primitive type, and must be regarded as reminiscent of the apes in their narrowness." * * *

The above were the essentials of the information we possessed about the Piltdown specimens up to recently. Meanwhile the find has been discussed at the late meeting (August, 1913) of the British Association for the Advancement of Science, as well as in some pub-

Smithsonian Report, 1913.—Hrdlička. PLATE 7.



RESTORATION OF THE PILTDOWN MANDIBLE (B), COMPARED WITH THAT OF MAN (C) AND YOUNG CHIMPANZEE (A), IN LEFT SIDE VIEW.

(After A. Smith Woodward.)

lications, and the latest of these is another important paper by Messrs. Dawson and Woodward,[1] in which appear details of considerable additional interest. From this publication we learn that the researches by the authors in the Piltdown gravel have continued; and that the whole bed at the locality of the find was found divided into four well-defined strata. The topmost of these consists of surface soil, with pieces of iron-stained subangular flint derived from some ancient gravel and similar to the flints beneath. This surface soil also contains a mixture of pottery and implements of various ages. Beneath is the second bed of "undisturbed" gravel varying from a few inches to three feet in thickness. A paleolithic implement figured in the former paper by the writers has been found in this layer, which contains rolled and subangular flints similar to those found above and below. The third stratum, though not always present, is well marked where it does occur by reasons of its dark ferruginous appearance, and chiefly consists of pieces of ironstone and rolled and subangular flints deeply patinated and iron stained. All the fossil bones, animal and human, with the exception of the remains of a deer, were discovered in or have been traced to this third dark bed, which rests unevenly upon a fourth layer, consisting of very pale yellow, finely divided sand and clay.

The whole of the work was perforce carried on very slowly, and it was found impossible to employ more than one laborer, "for the actual excavation had to be closely watched, and each spadeful carefully examined. The gravel was then either washed with a sieve, or strewn on specially prepared ground for the rain to wash it; after which the layer thus spread was mapped out in squares, and minutely examined section by section."

While the laborer was digging the disturbed gravel within two or three feet from the spot where the mandible was found, Mr. Dawson "saw two human nasal bones lying together with the remains of a turbinated bone beneath them *in situ*." In the gravel excavated within a radius of five yards of the spot where the mandible was found, Father Teilhard de Chardin, who worked for a few days with the authors, found on August 30, 1913, a remarkable canine tooth, which, according to Messrs. Dawson and Woodward, belongs to the Eoanthropus.

There were also found in the same vicinity two evidently worked flints with a flint flake; and there were also recovered fragments of teeth of the stegodon, rhinoceros, and mastodon.

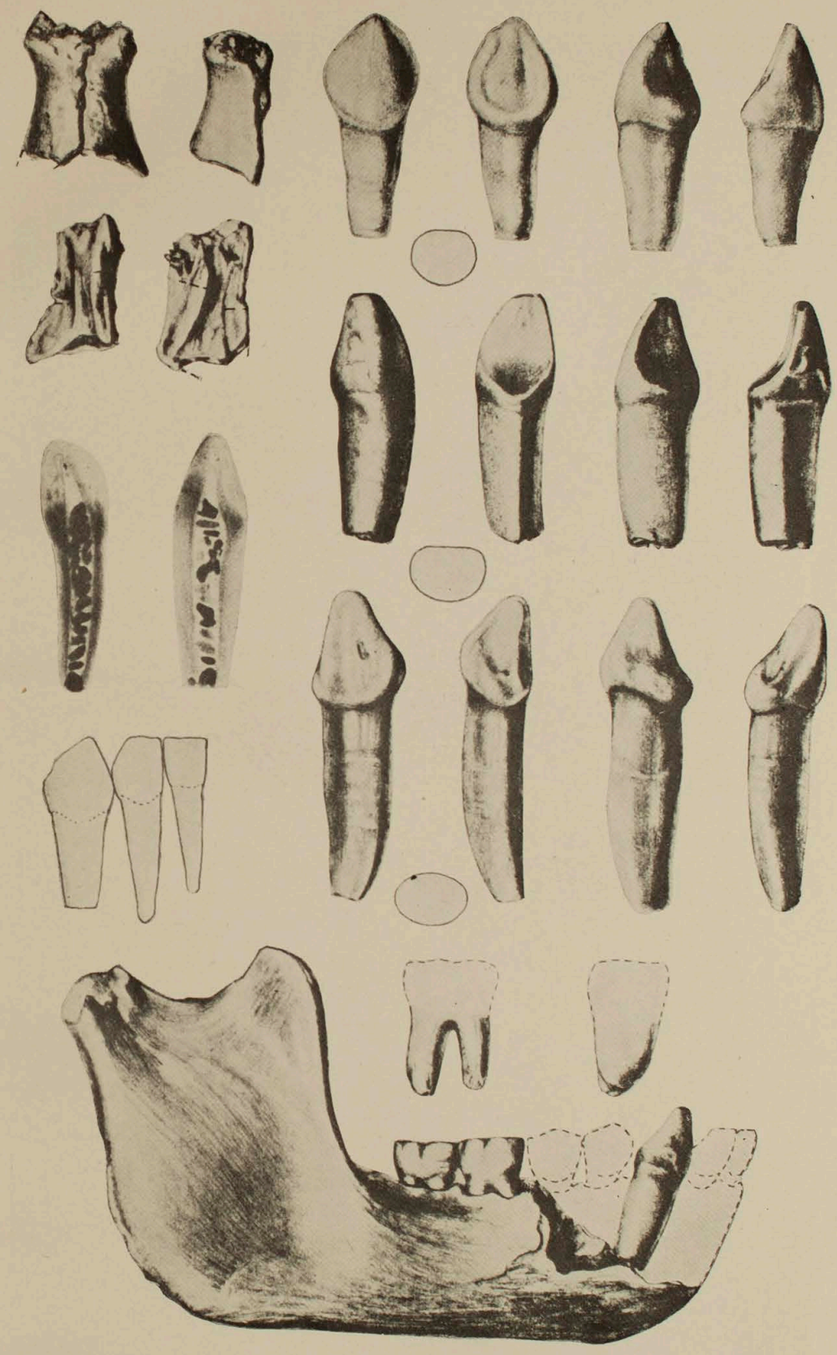
The conclusions of Messrs Dawson and Woodward are that the third or dark bed is, in the main, composed of Pliocene drift, probably reconstructed in the Pleistocene epoch.

[1] Supplementary Note on the Discovery of a Paleolithic Human Skull and Mandible at Piltdown (Sussex); Quart. Journ. Geological Society, London, April, 1914, pp 81–99.

"As regards the human remains discovered, including the canine tooth, there is nothing in their mode of occurrence to favor the idea that they may have belonged to different individuals. Putting aside the human remains and those of the beaver, the remains of the fauna all point to a characteristic land fauna of Pliocene age; and, though all are portions of hard teeth, they are rolled and broken. The human remains, on the other hand, although of much softer material, are not rolled, and the remains of beaver are in a similar condition. It would, therefore, seem that the occurrence of these two individuals belongs to one of the periods of reconstruction of this gravel, though for other reasons before stated by us, this is not perfectly certain."

The newly-found nasal bones (pl. 8) are "comparatively stout, and they are thickened at the upper border, suggesting a massive and somewhat overhanging brow ridge. * * * Comparison proves that these nasal bones resemble those of the Melanesian and African races, rather than those of the Eurasian type."

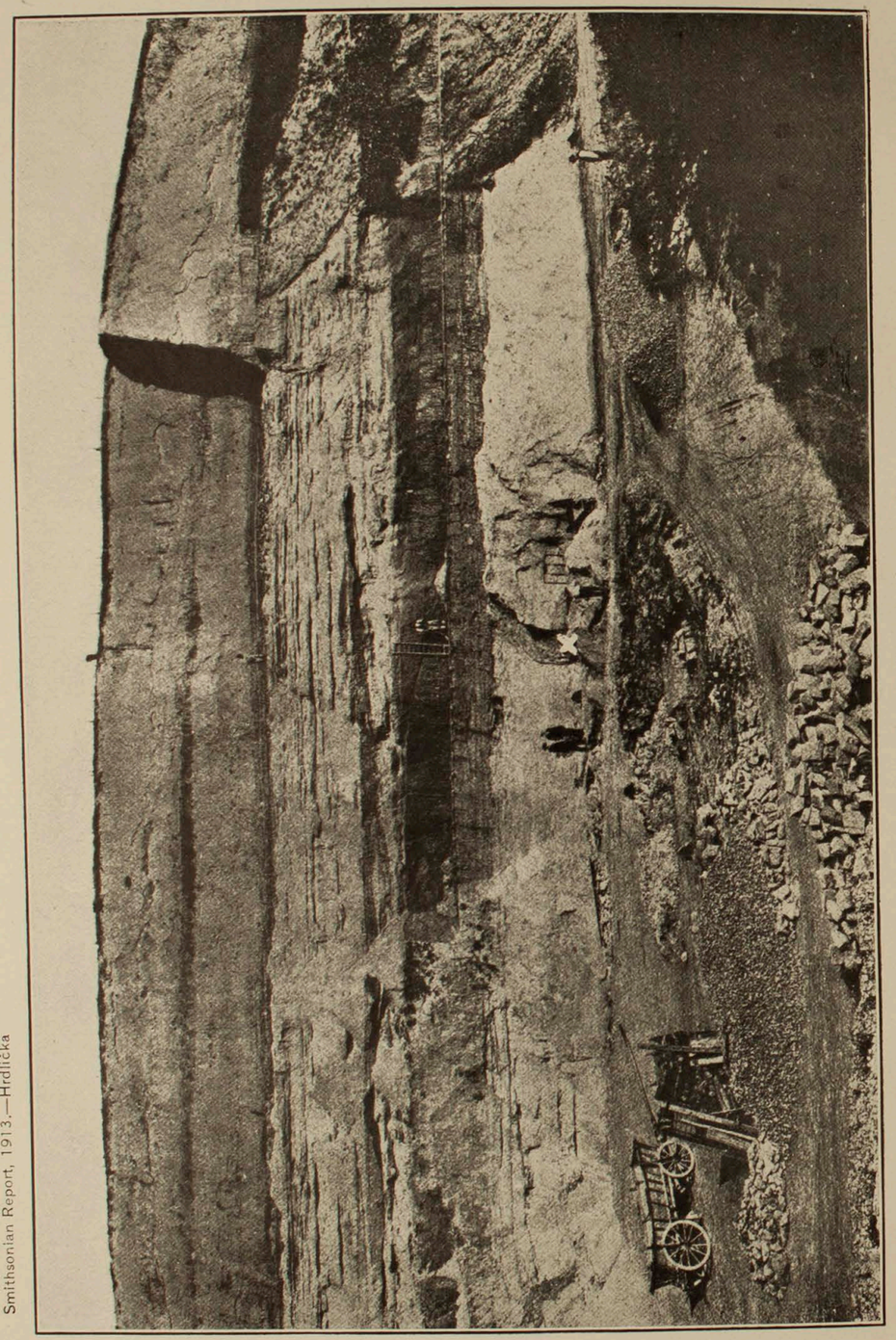
The remarkable new canine tooth (pl. 8) "is certainly that of a primate mammal, and may therefore be referred without hesitation to Eoanthropus. As it belongs to the right side of the mandible, corresponds in size with the jaw already found at the same spot, and agrees with the molar teeth in having been considerably worn by mastication, it may almost certainly be regarded as part of the specimen previously described. The crown of the tooth is conical in shape, but laterally compressed. * * * The tooth is distinctly larger than any hitherto found in genus *Homo* and differs fundamentally in having completely interlocked with its opposing tooth, which worked downward on its inner face as far as the edge of the gum. Its exact position in the jaw remains uncertain, but its crown must have risen well above the level of the other teeth, and its state of wear implies its separation from the anterior premolar by a slight diastema, as in the apes." From the various comparisons which the authors make it appear that "among known Upper Tertiary and Recent Anthropoids, the permanent lower canine of Eoanthropus agrees more closely in shape with the milk canine both of man and of the apes than with the corresponding permanent tooth in either of these groups. It is also obvious that the resemblance is greater between *Eoanthropus* and *Homo* than between the former and any known genus of apes. In other words, the permanent tooth of the extinct *Eoanthropus* is almost identical in shape with the temporary milk tooth of the existing *Homo*. Hence it forms another illustration of the well-known law in mammalian paleontology, that the permanent teeth of an ancestral race agree more closely in pattern with the milk teeth than with the permanent teeth of its modified descendants."



EOANTHROPUS.

The newly found nasal bones and canines (in various aspects and sections) and the lower jaw. (After Dawson and Woodward, Quart. Jour. Geol. Soc., vol. 70, pl. 15.)

PLATE 9.



Smithsonian Report, 1913.—Hrdlička

THE LOCALITY WHERE THE MAUER JAW WAS DISCOVERED.

The place where it lay, 79 feet from the surface, is marked by a white cross. (After Schoetensack.)

As to the original restoration of the skull, it appears that the changes called for by very detailed and many-sided further study, will be relatively small; and "there are reasons for believing that the individual was a young adult, and possibly a female, for the features that present secondary sexual characters in modern skulls are quite indefinite in these fragments."

Notes on an interesting discussion follow the report. There seems to be still some doubt as to the teeth belonging all to the same skull. As to the age of the remains, it can not be earlier than Pleistocene; according to Prof. W. Boyd Dawkins, this was clearly proved by the presence in the Piltdown deposits "of an antler of red deer (*Cervus elaphus*), a species unknown in the Pliocene of Europe and abundant in the Pleistocene and later strata."

Regrettably, at the time of the writer's visit in England, in the spring of 1912, the specimen was not yet available for examination by outsiders, and so no original opinion can be given concerning its status. It represents doubtless one of the most interesting finds relating to man's antiquity, though seemingly the last word has not yet been said as to its date and especially as to the physical characteristics of the being it stands for.

HOMO HEIDELBERGENSIS.

One of the oldest thoroughly authenticated skeletal relics so far discovered and attributable to a primitive human being, is the priceless specimen known as the Mauer jaw. This precious document of man's evolution is deposited in the Paleontological Institute of Heidelberg. For its preservation and thorough description we are indebted to Dr. Otto Schoetensack,[1] professor of Anthropology at Heidelberg University, who for years had been watching the finds in the sand pits near Mauer which eventually yielded the specimen. But considerable credit in this connection is due also to Herr Joseph Rösch, of Mauer, the owner of the sand pits in question, who saved the specimen from destruction, immediately called Prof. Schoetensack's attention to its discovery, and eventually donated it unselfishly to science.

The specimen, the lower jaw of an adult male, was discovered on the 21st of October, 1907, by two laborers. Both of these were still employed in the quarry at the time of the writer's visit, in June 1912, and they readily related, in company with Mr. Rösch, all the circumstances of the find.

The deposits in which the specimen was discovered are located near the village of Mauer, which lies in the picturesque Elsenz Valley, 6

[1] Recently deceased.

miles (10 km.) southeast from Heidelberg. They form the moderately elevated undulating northern boundaries of the shallow valley, at a distance of about 2 miles from the present bed of the river, and represent in the main the quaternary accumulations of the stream. They consist of loess, sand and gravels, with here and there, in the deeper layers, isolated flat blocks of red sandstone (pl. 9).

The portion of these deposits owned by H. Rösch, located about 500 paces north of the Mauer village, have now been worked, in open manner, for upward of 30 years, in which time great quantities of building sand have been removed. During this work, particularly in the lower strata, the workingmen often unearthed fossil shells and fossil bones of various Quaternary animals. Many of these specimens found their way, mostly as gifts of Herr Rösch, to the Heidelberg University, and the diggings were repeatedly visited by scientific men, among whom Prof. Schoetensack. Both the owner and the workmen were enjoined to watch for better preserved specimens, and particularly for anything relating to the presence of man.

On the date of the find, two of the laborers were working in undisturbed material at the base of the exposure, over 80 feet in depth from the surface, when one of them suddenly brought out on his shovel part of a massive lower jaw which the implement had struck and cut in two. As the men knew it was worth while to carefully preserve all fossils, the specimen was handled with some care. The missing half was dug out, but the crowns of four of the teeth broken by the shovel were not recovered. The men were struck at once with the remarkable resemblance of the bone to a human lower jaw; but it looked to them too thick and large to be that of man. They called Herr Rösch and he also was bewildered; but he recognized immediately that the specimen might be of considerable interest to Prof. Schoetensack and so he took charge of it. Returning to the village he telegraphed to the professor, who came the next day, and "once he got hold of the specimen, he would no more let it out of his possession." He took it to Heidelberg, cleaned it, repaired it, and in 1908 published its description in an exemplary way.[1] Since then the valuable specimen has been preserved in the Paleontological Institute of the Heidelberg University, where, thanks to the liberality of those in charge, it is available for examination to men of science.[2]

Shortly following the discovery of the jaw a most careful examination and study were made of the Mauer deposits. They were found to range from recent accumulations on the surface to Tertiary deposits in the lowest layers. The jaw lay a little less than three feet

[1] Shoetensack, Otto. Der Unterkiefer des Homo Heidelbergensis, aus den Sanden von Mauer bei Heidelberg, 4°, Leipzig, 1908, pp. 1–67, 13 plates.

[2] The writer wishes to thank herewith especially Prof. Wilhelm Salomon, chief of the Institute, for the courtesies extended.

(0.87 meter) above the floor of the excavation and 79 feet (24.1 meters) from the surface.[1] The same level, as well as some of the higher layers, yielded fossil bones of the *Elephas antiquus*, *Rhinoceros etruscus*, *Felis leo fossilis*, and various other extinct species. The age of the human jaw has been determined by these and subsequent explorations to be earlier Quaternary, though there seems to be some uncertainty as yet as to the exact subdivision of the period to which it should be attributed.

The original specimen, when seen, impresses one at once and potently as one of the greatest anthropological treasures. It is a huge lower jaw, which looks simultaneously both human and ape (pl. 10).

It presents no abnormality or any diseased condition that could have altered it in shape, so that it may well be regarded as a perfect representative of its type. The bone is dull yellowish-white to reddish in color, with numerous small and large blackish spots. The crowns of the teeth are dirty creamy white, with blackish discolorations on the somewhat worn-off chewing surfaces of the canines and incisors, and a few similar spots over the molars; while all the parts of the teeth beneath the enamel are dull red, as if especially colored. It is much mineralized and feels more like so much limestone than bone. It weighs nearly 7 ounces (187 grams).

The jaw is considerably larger and stouter than any other known human mandible. Its ascending rami are exceedingly broad. Its coronoid processes, thin and sharp in modern man, are thick, dull, broad, and markedly diverging. The chin slopes backward as in no human being now known or thus far discovered, with the possible exception of the recently reported Eoanthropus; and there are other primitive features. The total of the characteristics of the bone are such that, had the teeth been lost, it would surely have been regarded as the mandible of some large ape rather than that of any human being.

The teeth of the Mauer jaw, however, are perfectly preserved, and though large and provided with great roots and in various other ways primitive, they are unquestionably human teeth. They force the conclusion that their possessor, while of heavy, protruding face, hugh muscles of mastication, wide and thick zygomatic arches, thick skull, probably heavy brows, and possibly not yet quite erect posture, had nevertheless already stepped over that line above which the being could be termed human. His food and probably his mode of life were related to those of primitive man, and he was already far removed from his primate ancestors with large canines.

The writer will not enter into the anatomical details of the specimen, which have been admirably brought out by Prof. Schoetensack.

[1] The exact spot has been marked by Prof. Schoetensack with a stone monument bearing the inscription: "Fundstelle des menschlichen Unterkiefers, 21 Oktober, 1907."

The main dimensions of the bone as taken by the writer and contrasted with a modern male German jaw of average strength, are as follows:

Measurements of the Mauer jaw and those of an ordinary lower jaw of a white man of German descent.

	Mauer jaw.		German jaw.	
	Right side.	Left side.	Right side.	Left side.
	cm.		*cm.*	
Horizontal length (from the most forward point of the alveolar border in the middle, to the middle of the posterior border of the ascending ramus)	12.5	12.1	9.1	9.0
Breadth:				
Bigonial	10.8		10.0	
Bicoronoid	11.3		9.8	
Bicondylar	13.1		12.2	
Vertical height in the median line at front (the jaw reposing naturally on a horizontal surface)	5.2		4.5	
Height at middle of second molar	3.2		2.5	
Thickness (at right angle to the vertical diameter of the horizontal ramus) at median incisors and midway from above downward	1.8		.9	
At second molars	2.05		1.5	
Maximum (at third molars)	2.25		1.5	
Smallest breadth of the ascending ramus	5.2	5.0	2.8	2.7
Length of dental arch	5.85		5.4	
Breadth of the dental arch	7.05		6.4	
Length of the three molars, at insertion	3.55		3.3	

It is readily seen that the jaw exceeds considerably that of the modern man in every dimension.

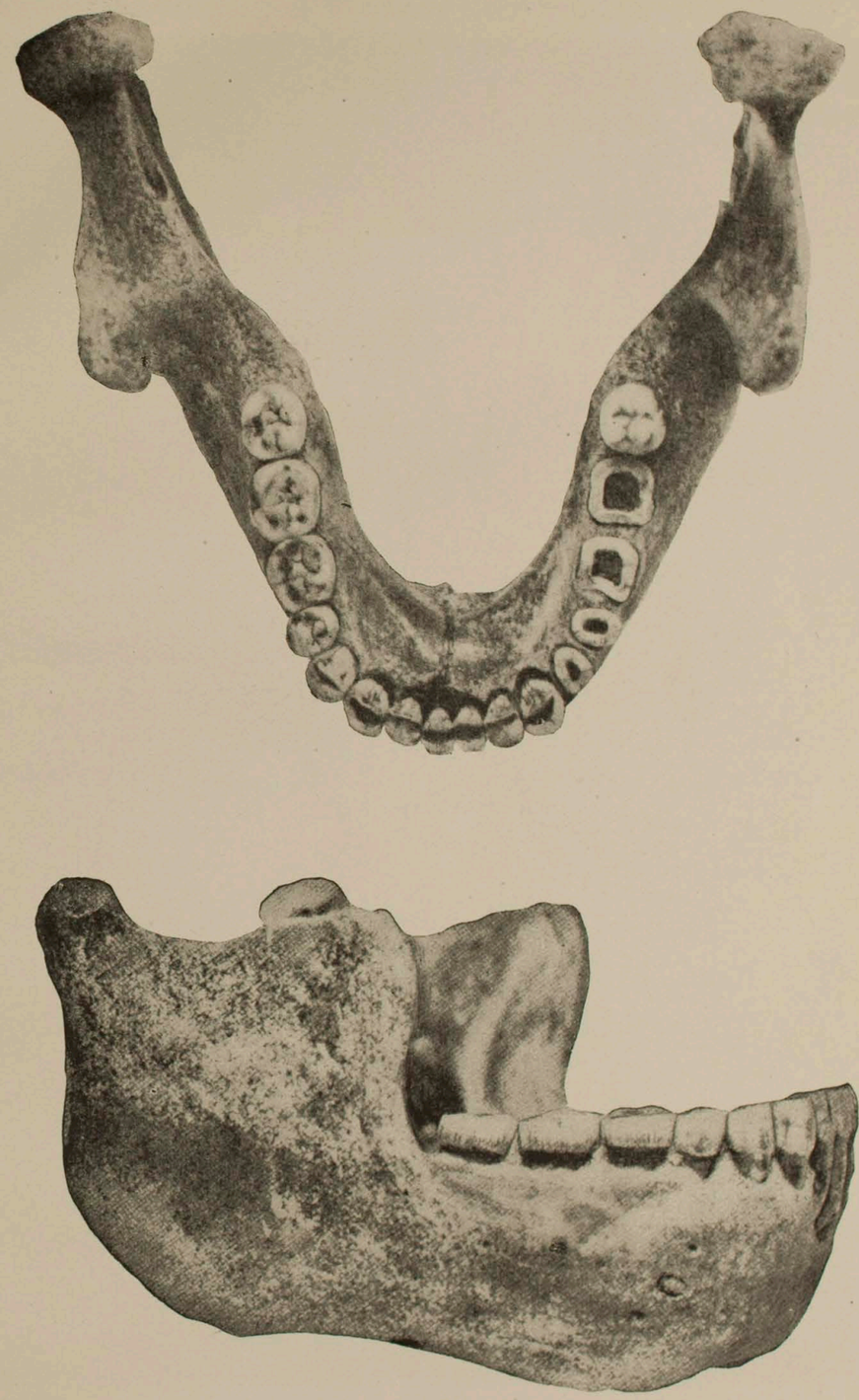
The carefulness of the workingmen in the Mauer sand deposits has been redoubled since the find of the jaw, and the locality has also been subjected to considerable scientific exploration, but thus far without further result so far as human remains are concerned. No signs were discovered which would indicate that the specimen found in 1907 proceeded from a burial. Evidently it became mingled accidentally and while still fairly fresh with the ancient alluvium, wherein by rare good fortune it was perfectly preserved. There can be but little hope that other parts of the same skull or skeleton will ever be recovered; but it is not impossible that the large early accumulations of the Elsenz Valley may inclose and some day yield parts of some equally early individual which will throw further light on the physical organization of this most interesting ancient representative of humanity.

THE SKULL OF GIBRALTAR.

This highly valuable but comparatively little known specimen is preserved in the Museum of the Royal College of Surgeons, England, where, thanks to the courtesy of the curator, Prof. Arthur Keith, the writer was able to examine it and have it photographed.

The history of the specimen is, regrettably, somewhat defective. The first mention of it occurs in Falconer's Paleontological Memoirs,[1]

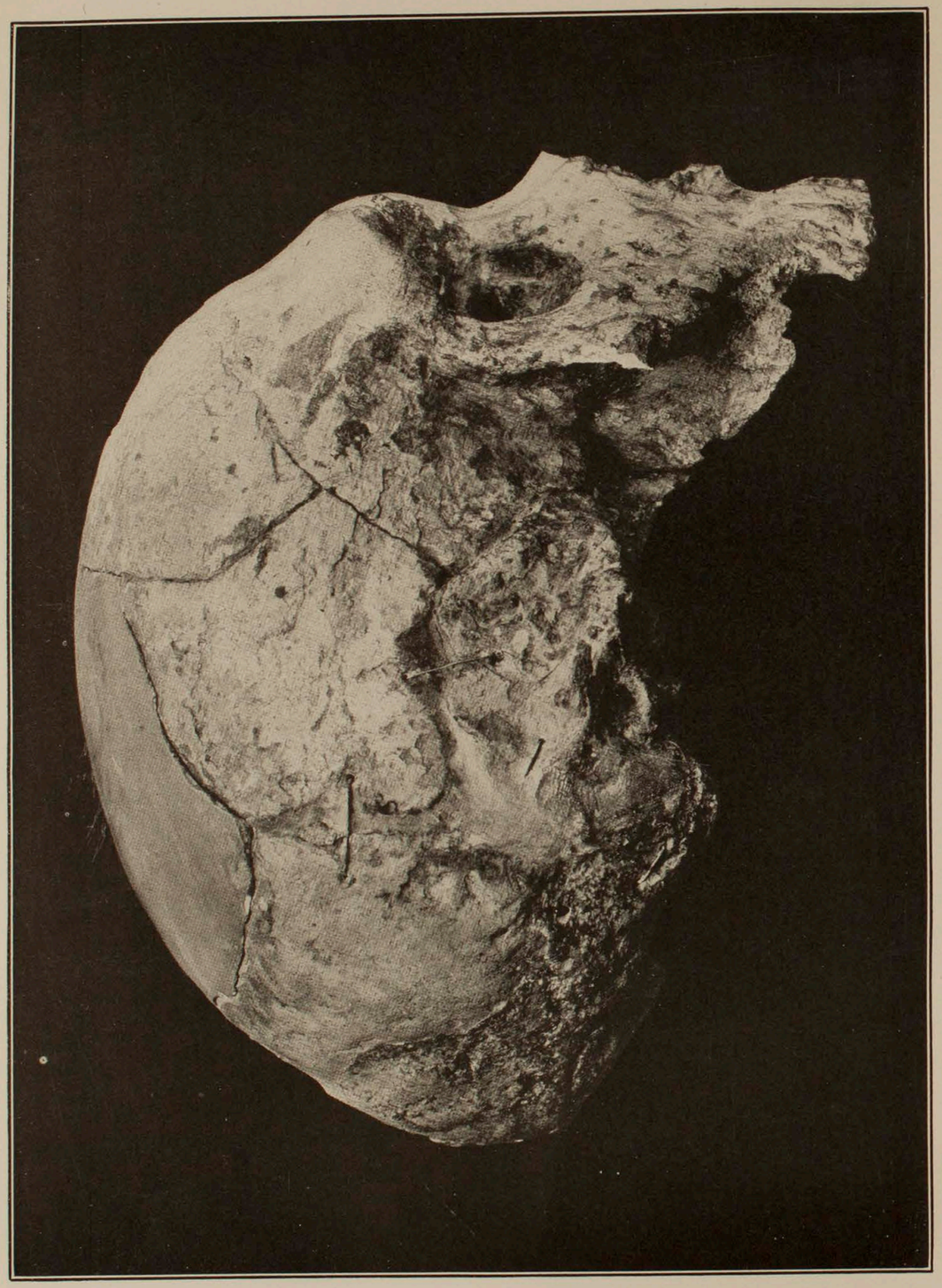
[1] Falconer, Hugh. Paleontological memoirs and notes, 2 vols., 8°, London, 1868; also Quart. Journ. Geol. Soc. London, vol. 21, 1865, p. 369.



THE MAUER LOWER JAW.

(After Schoetensack. About three-fourths natural size.)

PLATE 11.



THE GIBRALTAR SKULL. SIDE VIEW. (⅓.)
(Photographed for the Smithsonian Report from the original.)

Smithsonian Report, 1913.—Hrdlička.

in 1868, where, on page 561 of volume 2, speaking of various anthropological and other finds at Gibraltar, the author says:

> One of the human skulls yielded by the rocks many years since appears to us to point to a time of very high antiquity. In fact, it is the most remarkable and perfect example of its kind now extant. In the absence of a properly organized museum no record exists of the precise circumstances under which this interesting relic was found, and that it has been preserved at all may be considered a happy accident; it has cost us much labor, and with but partial success, to endeavor to trace its history on the spot where it turned up.

Besides this Falconer remarks in a letter to a relative,[1] referring to the skull: "It is a case of a very low type of humanity—very low and savage, and of extreme antiquity—but still man * * *.

Taking all the available data into consideration,[2] it appears that the skull was discovered, accidentally, as early as 1848, therefore eight years before the Neanderthal cranium made its appearance in the "Forbes Quarry, situated on the north front of the Rock of Gibraltar." According to Keith,[3] it was "quarried out of the terrace under the north face of the rock," a terrace formed of solidified breccia, consisting of the débris of weathering of the limestone cliff and fine wind-blown sand. The part of the terrace where the cranium lay was possibly in former times the floor of a cave. Part of a cave still exists behind the site of the discovery and was explored in 1911 by Duckworth, but without results. It is certain that the skull showed, and to some extent presents to this day, a hard stony matrix adhering to its surface and filling its cavities. Broca, to whom we owe the first descriptive account of the specimen[4] says that it was taken out from a "very compact and adherent gangue" out of which it was disengaged with much difficulty. The photographs published with Broca's account show still very noticeable remnants of the stony matrix (see also pl. 12).

The skull was presented to the Gibraltar Scientific Society by its that time secretary, Lieut. Flint, but for many years received no scientific attention. In 1862 it came to England, with the collections from the Gibraltar caves, and was studied to some extent by Busk and Falconer. The latter, perceiving how much it differed from recent human skulls, proposed to refer it to a distinct variety of man, the *Homo colpicus*, after Calfé, the old name of Gibraltar. In 1868 finally Busk presented the cranium to the Museum of the Royal College of Surgeons of England, where it is still preserved.

The first descriptive account of the specimen was published, as mentioned above, by Broca, but the adhering stony matrix pre-

[1] Op. cit., p. 561, footnote.
[2] Compare Keith, A. The early history of the Gibraltar cranium. (Nature, 1911, pp. 313–314.)
[3] Ancient Types of Man, 1911, p. 121.
[4] Broca, P. Crânes et ossements humains des cavernes de Gibraltar. (Bull. Soc. d'Anthropol. Paris, 2d séries, vol. 4, 1869, p. 154.)

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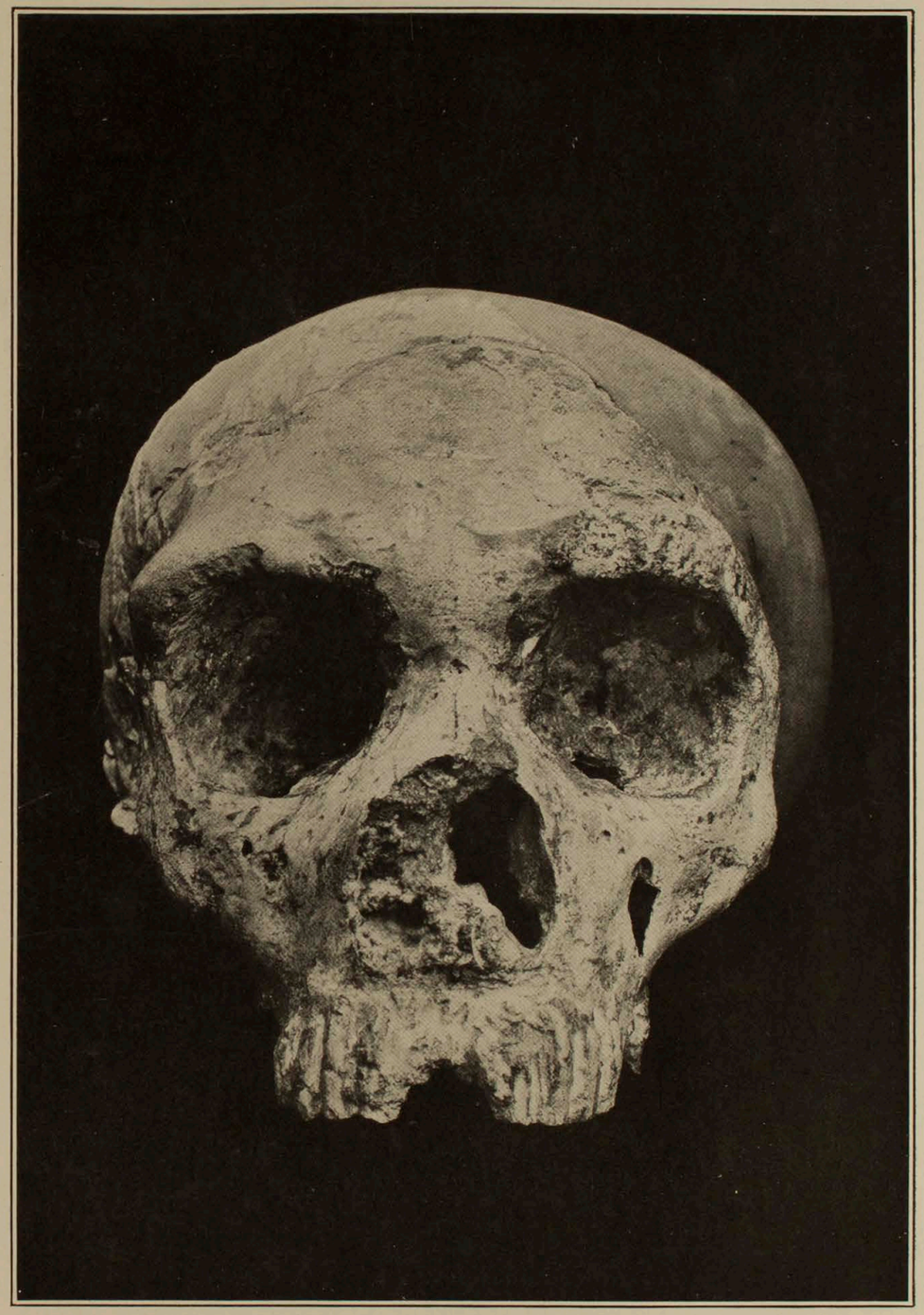
vented at that time any attempts at accurate measurements. Subsequently it received attention from Huxley, Quatrefages, and Hamy, and later from Macnamara, Klaatsch, Schwalbe, Sollas, Sera, and Keith, as well as the writer. It is a very remarkable specimen which, even though the geological and paleontological evidence relating to its antiquity is imperfect, does not allow for one moment any doubt as to its representing an early form of the human being; and its characteristics are such that it is now universally regarded as a representative, possibly a very early one, of the *Homo neanderthalensis*.

The cranium (pls. 11, 12, 13) is dirty yellowish to whitish in color. It is considerably mineralized. The stony matrix has been so far removed that all important determinations and measurements which the defective state of the bone itself permits, can now be made. A fortunate circumstance is that the frontal and facial parts are relatively well preserved; the vault on the other hand is largely defective, but even here sufficient portions remain to permit of a number of valuable determinations, and a fairly correct reconstruction.

The aspect of the face is semihuman, apish. There is a marked and quite heavy supraorbital arch, notwithstanding the fact that the skull is probably that of a female. The orbits are very spacious, especially in height, and the frontal process between, especially at the level of the superior borders of the orbits, is very stout. The nasal bridge is low, though not excessively so, and the nasal aperture is very broad. There are no suborbital (canine) fossæ—the surface of the maxillaries in this region is in fact slightly convex, as in the apes. The zygomatic arches are deficient and in consequence it is impossible to say anything definite about their breadth, except that in all probability this was considerable. The upper alveolar process is largely absorbed, so that we can not judge of the original prognathism, which however was doubtless well marked. The teeth show unusual strength and especially length, though their crowns are largely worn off.

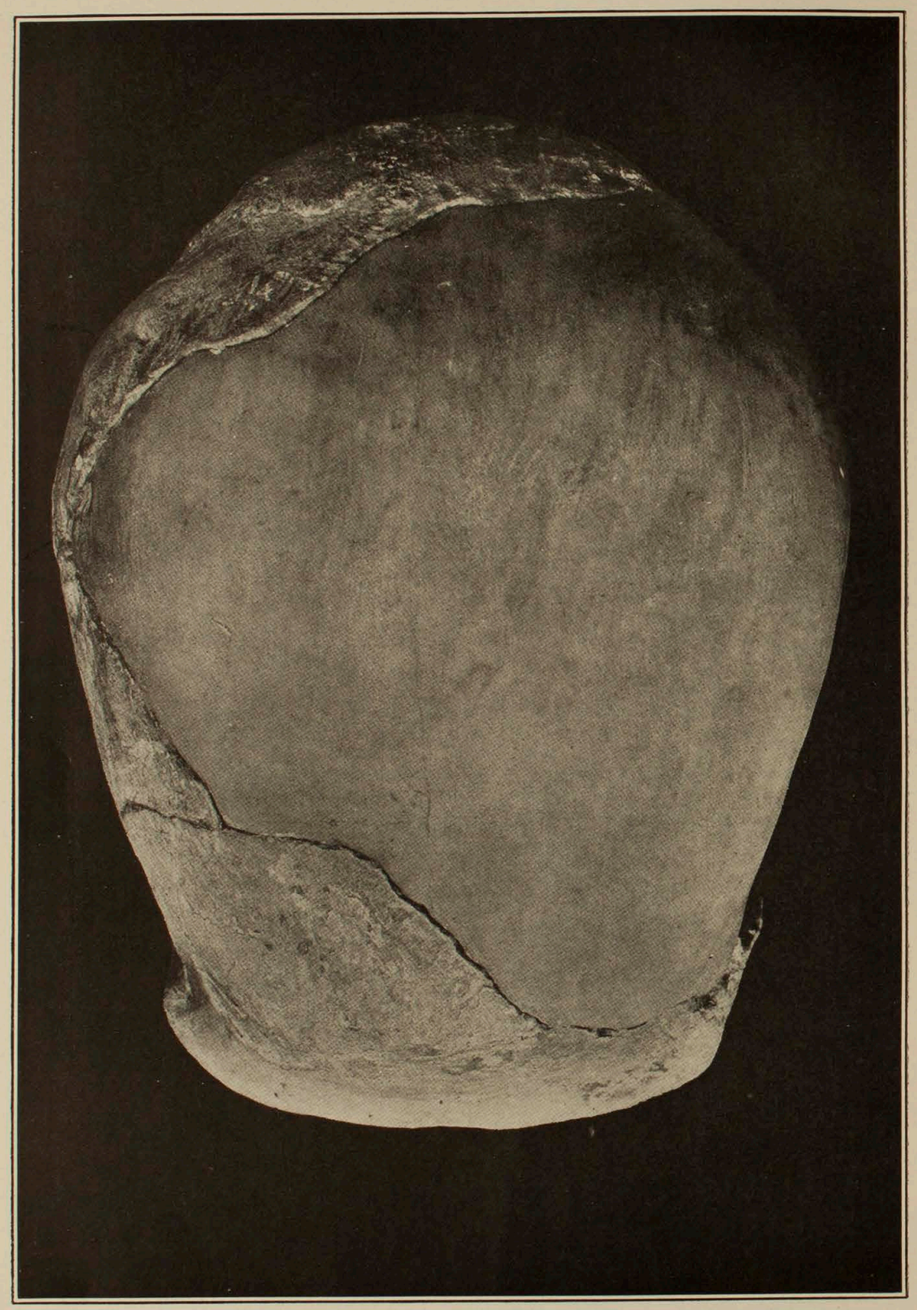
The vault, viewed from above, is ovoid in shape and decidedly low. The forehead is low and sloping. The cranial bones are thick, exceeding any in this line that can be found in normal modern European.

The external dimensions of the skull are fairly large, but the brain was small. The cranial capacity is estimated by Keith as having been under 1,100 c. c.—that in an adult white woman of the present time averaging about 1,325 c. c. The palate was large and approached the horseshoe in shape. The fossæ for the articulation of the lower jaw are rather small and, as in the Krapina skulls to be described later, they are inclined distally more upward than in man of the actual time.



THE GIBRALTAR SKULL. FRONT VIEW.

(Photographed for the Smithsonian Report from the original.)



GIBRALTAR SKULL. TOP VIEW.

(Photographed for the Smithsonian Report from the original.)

The principal measurements which the writer secured on the specimen, and which differ slightly from those previously reported, especially as to the breadth of the skull, are as follows:

	Cm.
Length maximum (glabello-occipital)	19.3
Breadth maximum, near	14.8
Cephalic index	76 to 77
Height between a point corresponding about to the bregma and a point on the basilar process just back of the vomer	10.8
Diameter frontal minimum	9.9
Upper alveolar point to nasion, approximately	7.9
Nose height (mean of the two sides)	5.8
Breadth maximum	3.4
Palate length (Turner's method), about	7.0
Breadth, about	6.8
	Mm.
Thickness of right parietal, 1 cm. above and along the squamous suture	6.9

	Right. *Cm.*	Left. *Cm.*
Orbits, height	4	3.8
Breadth	4	4.0
Maximum length of the brain		16.4

The majority of these measurements show well the low type of the skull.

There are numerous other details and dimensions about the specimen which are of interest to the anthropologist, but which can not well be dealt with in this paper. It will suffice to say that both the visual and the instrumental examination of the specimen lead to the conclusion that the Gibraltar skull represents a highly valuable remains of an early human being and that its principal characteristics justify the classification of this ancient form with the *Homo neanderthalensis*.[1]

THE NEANDERTHAL SKULL AND BONES.

The most famous of the skeletal remains representing early man are unquestionably the imperfect but highly characteristic specimens known as the Neanderthal skull and bones. This important find more than any other has aroused scientific men to intense realization of the earlier phases of human evolution. The skull and to some extent also the other parts of the skeleton stand morphologically far below those of any existing type of man, being correspondingly nearer to the ancient primates; and their name has been deservedly taken to designate with the entire early phase of mankind of which the skeleton is, as now well known, a prototype.

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[1] ADDITIONAL REFERENCES.

SERA, G. L. Nuove osservazioni ed induzioni sul cranio de Gibraltar. Arch. p. l'Antropol. and Etnol., vol. 39, Firenze, 1910, pp. 1–66, pls. 3–5.

SOLLAS, W. G. On the cranial and facial features of the Neanderthal race. (Philosophical Transactions, Roy. Soc. London, 1907, vol. 199B, p. 281–339.)

The skull, with other parts of the skeleton, were found in August, 1856.[1] They were dug out accidentally by two laborers from a small cave, located at the entrance of the Neanderthal gorge, in Westphalia, western Germany. The bones were given but little attention by the workmen, but fortunately news of the find reached an Elberfeld physician, Dr. Fuhlrott, and he was still able to save the skullcap, the femora, humeri, ulnæ, right radius, portion of the left pelvic bone, portion of the right scapula, piece of the right clavicle, and five pieces of ribs (see pls. 14–18).

Soon after their discovery the skeletal remains of the Neanderthal man received the attention of Prof. D. Schaaffhausen, of Bonn, who on the 4th of February, 1857, made a preliminary report upon them at the meeting of the Lower Rhine Medical and Natural History Society, of Bonn.[2] At the general meeting of the Natural History Society of Prussian Rhineland and Westphalia, at Bonn, on the 2d of June, 1857, Dr. Fuhlrott himself gave a full account of the locality of the find and of the circumstances under which the discovery was made.

The principal details of Dr. Fuhlrott's[3] report were as follows:

> A small cave or grotto, high enough to admit a man and about 15 feet deep from the entrance, which is 7 or 8 feet wide, exists in the southern wall of the gorge of the Neanderthal, as it is termed, at a distance of about 100 feet from the Düssel[4] and about 60 feet above the bottom of the valley (fig. 3). In its earlier and uninjured condition this cavern opened upon a narrow plateau lying in front of it and from which the rocky wall descended almost perpendicularly to the river. It could be reached, though with difficulty, from above. The uneven floor was covered to a thickness of 4 or 5 feet with a deposit of mud, sparingly intermixed with rounded fragments of chert. In the removing of this deposit the bones were discovered. The skull was first noticed, placed nearest to the entrance of the cavern; and further in were the other bones lying in the same horizontal plane. Of this I was assured in the most positive terms by two laborers who were employed to clear out the grotto, and who were questioned by me on the spot. At first no idea was entertained of the bones being human; and it was not till several weeks after their discovery that they were recognized as such by me and placed in security. But, as the importance of the discovery was not at the time perceived, the laborers were very careless in the collecting and secured chiefly only the larger bones; and to this circumstance it may be attributed that fragments merely of the probably perfect skeleton came into my possession.

Fuhlrott held that the Neanderthal bones might be regarded as "fossil," by which he possibly meant not merely mineralized, but

[1] In many publications the date is erroneously given as 1857.

[2] Verhandl. d. naturhist. Vereins der preuss. Rheinlände und Westphalens, vol. 14. Bonn, 1857. Also "Zur Kenntniss der ältesten Rassenschädel," Müller's Archiv, 1858, p. 453 et seq.

[3] Ib. Correspondenzblatt No. 2. The above follows G. Busks's Translation of Schaaffhausen's "On the crania of the most ancient races of man," Nat. Hist. Review, April, 1861.

[4] Near Hochdal, between Elberfeld and Düsseldorf.

PLATE 14.

THE NEANDERTHAL SKULL. SIDE VIEW.
(Photographed for the Smithsonian Report from the original.)

THE NEANDERTHAL SKULL. TOP VIEW.

(Photographed for the Smithsonian Report from the original.)

also belonging to a form of humanity no more existing. A little later Prof. Schaaffhausen arrived at the following conclusions:[1]

First. The extraordinary form of the skull was due to a natural conformation, hitherto not known to exist even in the most barbarous races. Second. These remarkable human remains belonged to a period antecedent to the time of the Celts and Germans, and were in all probability derived from one of the wild races of northwestern Europe, spoken of by Latin writers, and which were encountered as autochthones by the German immigrants. And third. It was beyond doubt that these human relics were traceable to a period at which the latest animals of the Diluvium still existed; though no proof of this assumption, nor consequently of their so-termed fossil condition, was afforded by the circumstances under which the bones were discovered.

In 1860 the Neanderthal cave was visited, in company with Dr. Fuhlrott, by Lyell, who made a sketch of the locality (fig. 3), and

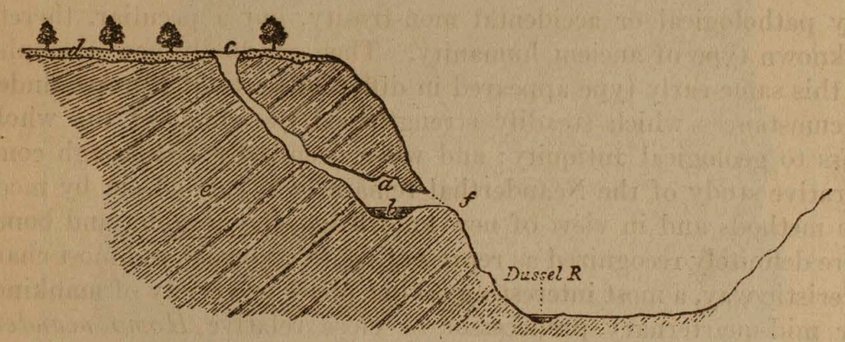


FIG. 3.—SECTION OF THE NEANDERTHAL CAVE, NEAR DÜSSELDORF. (After Lyell.)

a. Cavern 60 feet above the Düssel, and 100 feet below the surface of the country at *c*.
b. Loam covering the floor of the cave, near the bottom of which the human skeleton was found.
b, *c*. Rent connecting the cave with the upper surface of the country.
d. Superficial sandy loam.
e. Devonian limestone.
f. Terrace, or ledge of rock.

we are given the following additional information:[2] Since the discovery of the bones—

the ledge of rock, *f*, on which the cave opened, and which was originally 20 feet wide, had been almost entirely quarried away, and, at the rate at which the work of dilapidation was proceeding, its complete destruction seemed near at hand.

In the limestone are many fissures, one of which, still partially filled with mud and stones, is represented in the section at *a c* as continuous from the cave to the upper surface of the country. * * *

There was no crust of stalagmite overlying the mud in which the human skeleton was found, and no bones of other animals in the mud with the skeleton; but just before our visit in 1860 the tusk of a bear had been met with in some mud in a lateral embranchment of the cave, in a situation precisely simi-

[1] L. c.

[2] Lyell, Sir Charles. The geological evidences of the antiquity of man, 4th ed., London, 1873, p. 80 et seq.

lar to *b*, figure 3, and on a level corresponding with that of the human skeleton. This tusk, shown us by the proprietor of the cave, was 2½ inches long and quite perfect; but whether it was referable to a recent or extinct species of bear, I could not determine.

Following the early notices concerning the Neanderthal cranium, and before other specimens of similar nature, such as the Spy, Gibraltar and others became known, an extensive controversy arose as to the real significance of the find. Virchow,[1] and after him others, were at first inclined to look upon the skull as pathological; to Barnard Davis[2] its sutures appeared to show premature synostosis; while Blake[3] and his followers regarded the specimen as probably proceeding from an idiot. But there were also those, such as Schaaffhausen, Broca, and others, who from the beginning saw in the cranium (the other bones received at first but little attention) not any pathological or accidental monstrosity, but a peculiar, thereto unknown type of ancient humanity. Then gradually new examples of this same early type appeared in different parts of Europe, under circumstances which steadily strengthened the claim of the whole class to geological antiquity; and when eventually a thorough comparative study of the Neanderthal remains was carried out by modern methods and in view of new knowledge, the cranium and bones were definitely recognized as representing, in a normal and most characteristic way, a most interesting earlier phase or variety of mankind, our mid-quarternary predecessor or close relative *Homo neanderthalensis*. The credit for deserving work in this field is due especially to Prof. G. Schwalbe, of Strassburg, whose numerous publications on the early forms of human remains in Europe are well known to every anthropologist.[4]

Notes on the specimens.—The remains of the Neanderthal skeleton are preserved in the Provincial Museum at Bonn, where, due to the courtesy of the director, Prof. Hans Lehner, the writer was enabled to examine the originals and later have them photographed.

The skull (pls. 14–16) is gray in color, with large mud-brownish patches on the outside, and whitish gray to whitish brown on the inside. It is decidedly heavy and mineralized. It is plainly nonpathological. The sagittal suture has evidently closed earlier than it ordinarily does in the modern man, but this must have taken place after the brain ceased to influence the cranial vault, for it resulted in no deformation. The coronal suture is obliterated up to the

[1] Virchow, R. Untersuchung des Neanderthal-Schädels. Zeit. f. Ethnol., vol. 4, 1872, Verhandl. Berl. Ges. f. Anthr., etc., pp. 157–165.

[2] Davis, J. Barnard. The Neanderthal skull, etc., London, 1864.

[3] Blake, C. Carter. On the alleged peculiar characters and assumed antiquity of the human cranium from the Neanderthal. (Journ. Anthrop. Soc., London, vol. 2, 1864, pp. 139–157; also Mem. Anthrop. Soc., London, vol. 2, 1866, p. 74.)

[4] Those especially worthy of mention in this connection are: Uber die Schädelformen der ältesten Menschenrassen, mit besonderer Berücksichtigung des Schädels von Egisheim. Mitteilungen der philomathischen Gesellschaft in Elsas-Lothringen. 5, Jahrg., vol. 3, 1897. Derselbe: Der Neandertalschädel. Bonner Jahrbücher, Heft 106; 72 Stn. 1 Tafel, 1901.

PLATE 16.

THE NEANDERTHAL SKULL. BACK VIEW.
(Photographed for the Smithsonian Report from the original.)

Smithsonian Report, 1913.—Hrdlička.

temporal ridges, while the lambdoid is still patent. Similar conditions to these are not seldom met with in the skulls of persons beyond the fiftieth year of life, and if not attended by scaphocephaly or other consequent deformation, can not be regarded as abnormal. The serration of the lambdoid suture is decidedly simpler than in the modern human skull.

The facial and basal parts are lacking. The vault shows very good dimensions in length and breadth, but is strikingly low, and the bones are considerably thicker than in the white man of to-day, so that the brain cavity was only moderate.

Besides its lowness the vault is characterized by a very decided protrusion of the whole supra-orbital region. The supra-orbital forestructure or arch formed through this protrusion is heavier than in any other known example of the *Homo neanderthalensis*. The line from glabella to the naso-frontal articulation is relatively extensive and passes considerably backward besides downward, indicating a very marked depression at the root of the nose, not unlike that which is present in the adult gorilla. Due also to the forward extension of the supra-orbital arch, the upper parts of the planes of the orbits face very perceptibly downward, while in present man they face somewhat upward or approach the vertical. The remarkable extent of the protrusion of the supra-orbital region may be judged by the fact that the horizontal distance from the most prominent point of the glabella to the nearest point on the ventral surface of the lower frontal region measures 3 cm. The frontal process descends deep between the orbits and is exceedingly stout.

The forehead is very low and also slopes markedly backward, nevertheless it presents a moderately well-defined convexity. The sagittal region is oval from side to side, much like that in man of to-day; the occiput, however, is marked by a relatively high situation of the crest and other peculiarities. The outline of the vault, as looked at from above, is a long ovoid. The thickness of the frontal bone at the eminences is 8.5 mm.; of the left parietal, along and 1 cm. above the squamous suture, 6 to 8 mm.; these measurements are about one-third greater than those of the skull of an average modern European.

The principal external dimensions of the cranium, taken carefully with two separate instruments, were found to differ slightly from some of those recorded, but agree closely with those of Schwalbe. They are:

	Cm.
The greatest length	20.1
The greatest breadth	14.7
Cephalic index	73.1
Diameter frontal minimum	10.7
Diameter frontal maximum	12.3
Nasion-bregma diameter	11.7
Bregma-lambda diameter	10.3

The internal capacity of the skull has been estimated by Schaaffhausen at 1,033 c. c., by Huxley at 1,230 c. c., and by Schwalbe at 1,234 c. c.

The brain which filled the skull was lower and narrower and slightly more pointed than the human brain of to-day, approaching in these features more the anthropoid form. The right frontal lobe was slightly larger and longer than the left, and the whole right hemisphere was slightly longer than that of the opposite side. In the present man it is generally the left hemisphere which is the longer, but this exception in the Neanderthal man is not necessarily of any special significance.

The long and other bones of the skeleton (pls. 17–18), so far as preserved, show many features of anthropological inferiority, demonstrating plainly that not merely the skull, but the whole body of the Neanderthal man occupied a lower evolutionary stage than that of any normal human being of the historic times. However, many of the details on these points are technical and must be reserved for another publication. The bones in general indicate a powerful musculature. They belong doubtless to a male individual. The stature of the man was about like the average of the present man in central Europe, or but slightly lower (the femora indicate, according to Manouvrier's scale, approximately 165 cm.)[1] The thigh bones, besides presenting a powerful neck with a relatively large head, show also a very mesially located minor condyle, certain peculiarities of the shaft, a small but distinct suprapatellar fossa which does not exist any more in man of this day, and a slight convexity, especially on the right, of the popliteal surface, a region which in the present man is as a rule more or less concave. The left humerus shows signs of an injury in consequence of which it doubtless remained much weaker than the right bone. The proximal end of the left ulna has also been damaged in life. The radius presents a marked functional (nonpathological) curvature.

A careful examination and comparison of the Neanderthal skull and bones can leave only one impression on the anatomist or anthropologist of to-day, which is that while individually and jointly the various parts represent a human being already far advanced above any anthropoid, they are still in many respects decidedly more primitive in form—that is, on a lower scale of evolution—than the skull and bones of any man of to-day.

The remains are unquestionably the most precious representatives of the important phase of early humanity which we now include under the name of *Homo neanderthalensis*.

[1] Taking all the long bones of the skeleton, so far as preserved, into consideration, the calculated stature is 163.2 cm. See Boule, M., Annales de Paléontologie, vol. 7, No. 2, 1912, p. 117; also Rahon, Thèse, Paris, 1892; and Mem. Soc. d'Anthropol, Paris, vol. 4, 1893, p. 403.

THE NEANDERTHAL FEMORA, WITH PORTION OF A SCAPULA AND PELVIC BONE.
(Photographed for the Smithsonian Report from the originals.)

BONES FROM THE UPPER LIMBS AND THORAX OF THE NEANDERTHAL SKELETON.
(Photographed for the Smithsonian Report from the originals.)

THE SPY SKELETONS.

In June of 1886 Messrs. Marcel de Puydt, member of the Archæological Institute of Liege, and Maximin Lohest, at that time assistant of geology of the University of Liege, discovered in the terrace fronting a certain cave at Spy, in the Province of Namur, Belgium, the remains of two human skeletons associated with the débris of extinct Quaternary animals. The discovery was immediately brought to the attention of Prof. J. Fraipont, of the Liege University, and on the 16th of August, 1886, he announced the important find to the Congrès archéologique of Namur. A little later in the same year Messrs. Fraipont and Lohest published an account of the discovery, with a description of the human remains, in the Bulletins of the Royal Academy of Belgium.[1]

According to the last-mentioned account there existed in the eighties in the community of Spy, above the stream Orneau and in

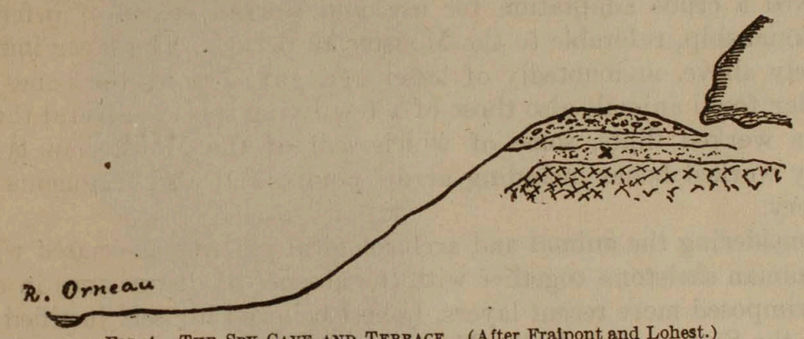


FIG. 4.—THE SPY CAVE AND TERRACE. (After Fraipont and Lohest.)
× = position of the skeletal remains of the Spy man.

the side of a wooded mountain, a cave, in which de Puydt and Lohest conducted archæological explorations since August, 1885 (fig. 4). A large terrace situated in front of the cave had not been methodically examined until 1886, and it was during excavations in this terrace that the two investigators encountered, in June of 1886, the human remains known since as the Spy skeletons.

The human bones lay in the lowest parts of the deposits, one 6, the other 8 meters in front of the entrance to the cave. They represented two individuals. One of these lay on its side, the hand touching the lower jaw; in the case of the other the original position could not be determined.

The terrace containing the Spy skeletons was situated 14.5 meters (47.5 feet) above the shallow bed of the stream running at the foot of the mountain, and the bones lay at the depth of 13 feet from

[1] Fraipont, J., and M. Lohest. La race humaine de Neanderthal ou de Canstadt en Belgique. Bulletins de l'Académie Royale de Belgique, 3d series, vol. 12, 1886, pp. 741–784.

the surface. The accumulations which formed the terrace included calcareous débris, various archæological traces of man's presence, and numereous remains of fossil animals. They could be separated into several strata, none of which showed any perceptible disturbance.

The layer in which the human skeletons were inclosed yielded also bones of the following fossil Quaternary mammals:

Rhinoceros tichorhinus (abundant).
Equus caballus (very abundant).
Cervus elaphus (rare).
Cervus tarandus (very rare).
Bos primigenius (fairly abundant).
Elephas primigenius (common).
Ursus spelæus (rare).
Meles Taxus (rare).
Hyæna spelæa (abundant).

This layer further contained a sliver of an animal bone which showed a crude adaptation for use, and worked stones of inferior workmanship, referable to the Mousterian period. The layer immediately above, undoubtedly of lesser age, gave besides the bones of similar fossil animals also those of a few living species, several thousands worked flints, some of which still of the Mousterian type, many worked bones including arrow points, and also fragments of pottery.

Considering the animal and archæological remains associated with the human skeletons, together with the absence of disturbance in the superimposed more recent layers, Lohest believed himself justified to refer the Spy remains to the Mousterian period; and the deductions of Fraipont, based on the study of the skeletal remains themselves, were that they belonged to the Neanderthal man. Since then the Spy remains have received careful consideration by every student of early man and the above classification was found to need no radical revision.

What remains of the Spy skeletons is preserved[1] in the collections of the University of Liege, where, thanks to the courtesies of Messrs. M. Lohest, Charles Fraipont and J. Sérvais, the writer was enabled to examine the originals.

The skeletons are currently known as No. 1 and No. 2. The remains of No. 1 comprise the vault of the skull; two portions of the upper jaw, with five molars and four other teeth; a nearly complete lower jaw, with all (16) teeth; the left clavicle; the right humerus, which has lost its upper epiphysis, and the shaft of the left humerus; the left radius, without lower epiphysis; the heads of the two ulnæ; a nearly complete right femur; the complete left tibia; and the right os calcis. The parts that have been identified as belonging to the second subject are the vault of the skull, two portions of the upper

[1] Was, up to the invasion in 1914.

SPY SKULL NO. 1. SIDE VIEW.
(After Fraipont.)

maxilla with teeth, two fragments of the lower jaw with teeth, some loose teeth belonging to the lower jaw, fragments of the scapulæ and left clavicle, imperfect humeri, the shaft of the right radius, portions of the ulnæ, the left femur without its lower extremity, the left os calcis, and the left astragalus. The separation as here given needs, however, a careful revision. Besides the above, there are a number of vertebræ and small bones of hands and feet about which it is impossible to say to which skeleton they belong.

All the skeletal pieces show an advanced state of mineralization. In color they range from brownish to dark grayish, skull No. 1 representing the former and No. 2 the latter shading; the teeth, however, are quite white, with yellowish roots, much as in crania from relatively modern burials.

The bones of skeleton No. 1 are in general weaker than those of No. 2, but whether this is due to sexual difference of the two individuals, or is merely accidental, is difficult to determine. No. 2 was of a decidedly powerful musculature. The stature of the Spy man, so far as it can be determined from these remaining bones, was slightly less than that of the Neanderthal man and somewhat below the medium of white man of central Europe of the present day.

The bones of the vault in the two skulls are thicker than in the average man of the present day, though slightly less so than in the Neanderthal cranium. The sutures in both are patent with the exception of the coronal in No. 1, which shows commencement of obliteration; their serration is very simple.

The two skulls are plainly normal specimens, free from disease or deformation, and belonged to adults, approaching in No. 1 middle age, while No. 2 was younger. Somatologically they are remarkable for their important resemblances as well as differences. They belong to one type, but represent individual variations of this type that stand far apart.

No. 1 (pls. 19–20) is almost a replica of the Neanderthal cranium. There is a similarly prominent, though not quite as heavy, supra-orbital arch; the forehead is even a trace lower and a trace more sloping than in the Neanderthal skull, and the general shape of the vault is much the same. The vault is also very low, but the sagittal region shows a slightly more perceptible elevation than that in the Neanderthal specimen (fig. 5).

Skull No. 2 on the other hand, while possessing similar prominent supra-orbital arch as No. 1, has a considerably higher and more convex forehead, the whole vault is higher as well as more spacious, and the form approaches in many respects that in modern man (pl. 21). The brain cavity in No. 1 is anteriorly low and relatively narrower, as well as somewhat more pointed, than in recent human crania; in No. 2 these features are also more like those in the present man.

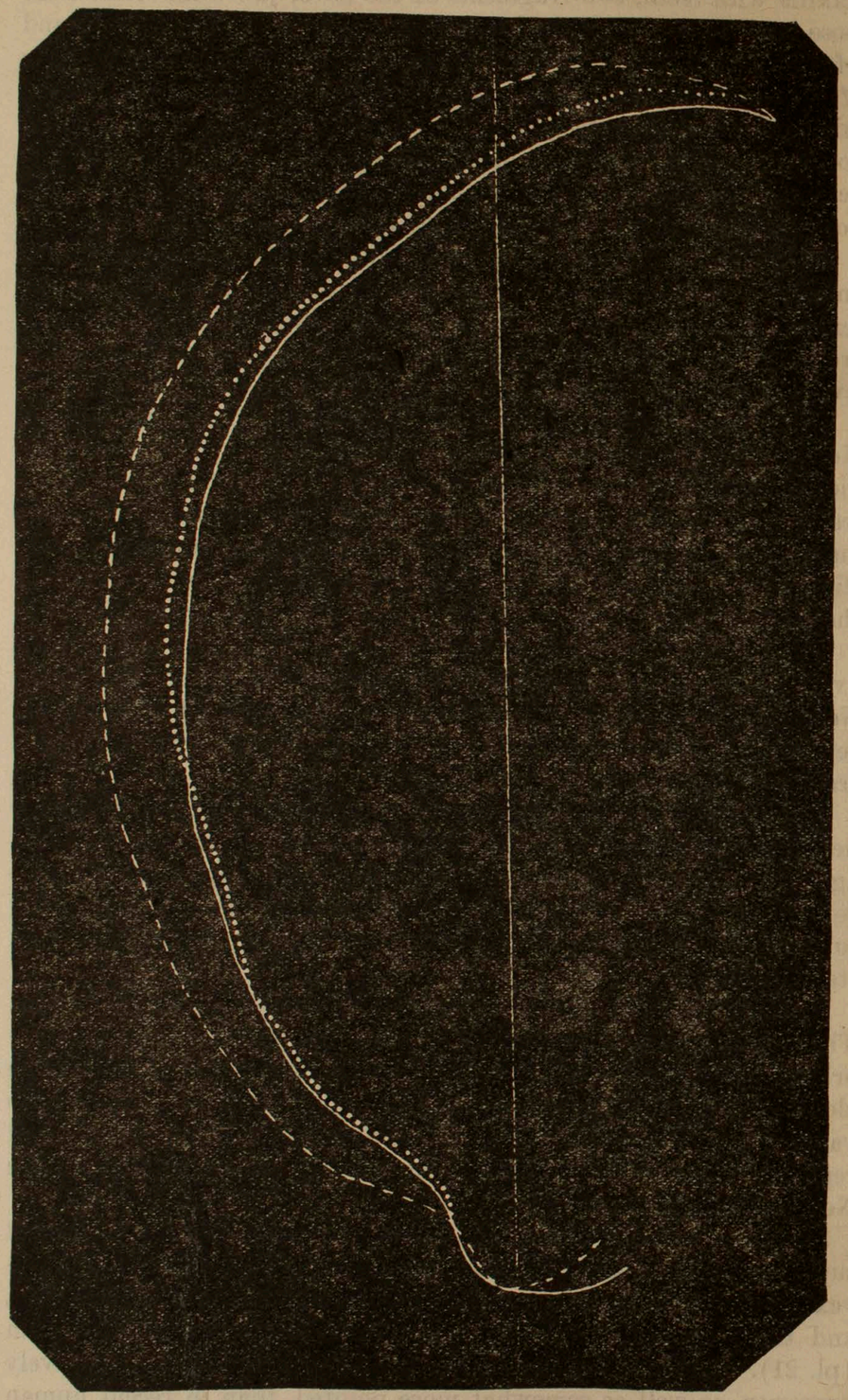


FIG. 5.—PROFILES OF THE NEANDERTHAL AND SPY CRANIA, SUPERIMPOSED. (After Fraipont and Lohest.)
—— Neanderthal. ..... Spy No. 1. - - - - - Spy No. 2.

PLATE 20.

SIDE VIEW OF SPY SKULL NO. 1.
(After Fraipont and Lohest.)

Smithsonian Report, 1913.—Hrdlička.

PLATE 21.

SIDE VIEW OF SPY SKULL NO. 2.
(After Fraipont and Lohest.)

Smithsonian Report, 1913.—Hrdlička.

On the whole it may be said that No. 2, while in some respects still very primitive, represents morphologically a decided step from the Neanderthaloid to the present-day type of the human cranium.

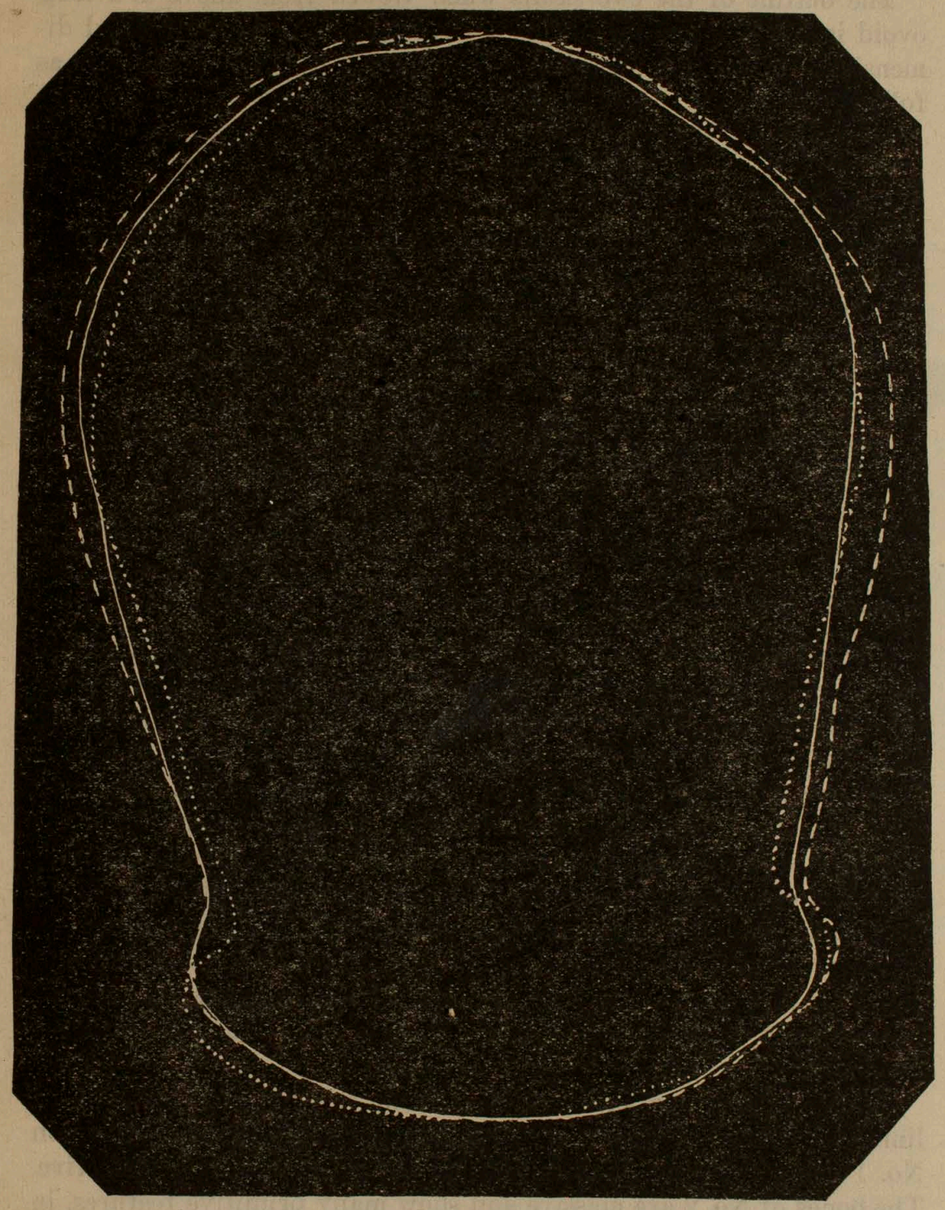


FIG. 6.—SUPERPOSITION OF NORMA VERTICALIS OF THE SPY NO. 1 AND NO. 2, AND THE NEANDERTHAL CRANIA.

——— Neanderthal. ..... Spy No. 1. - - - - - Spy No. 2.

The lower jaw of No. 1 (pls. 19, 22), while yet of a primitive form, possesses nevertheless already a trace of the chin prominence, and in size and anatomical characteristics is closer to the present-day form

than any of the other known lower jaws dating from the Mousterian period; and the same is true of the teeth which, though considerably worn, were evidently much like human teeth of to-day.

The outline of the two skulls when viewed from above is a long ovoid in No. 1, a shorter ovoid in No. 2 (fig. 6). The principal dimensions of the two specimens as secured by the writer are as follows:

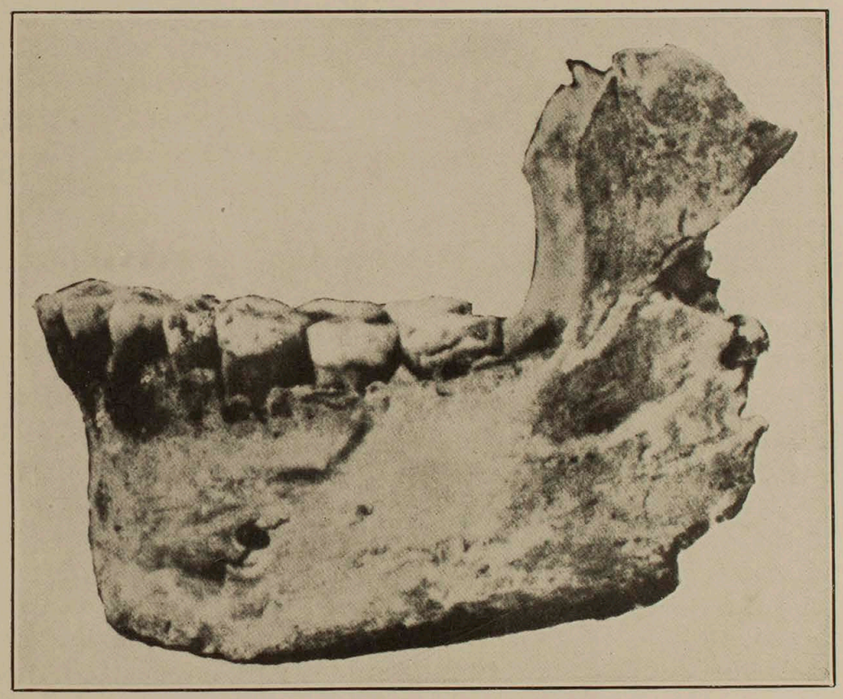
	No. 1.	No. 2.
	Cm.	Cm.
Length, maximum, from glabella	20.3	20 (?)
Length from ophryon	18.8	18.6
Breadth maximum	14.7	15.4
Cephalic index	72.4	[1]77
Diameter frontal minimum	10.3	10.9
Nasion bregma diameter	10.6	(?)
Diameter bregma-lambda	11.3	10.8
	Mm.	Mm.
Thickness of the left parietal along and 1 cm. above the squamous suture	6 to 8	5 to 8
Thickness of the frontal at the eminences	9	8
	Cm.	Cm.
Height of lower jaw at symphisis	3.55	------
Thickness at symphisis (excluding genial tubercle)	1.3	------
Thickness at second molar	1.5	[2]1.4
Maximum thickness (opposite third molar)	1.7	1.6

A careful consideration of the evidence presented by the two crania leads the writer to a slightly modified conclusion from the one generally accepted. The specimens are justly classified with the *Homo neanderthalensis;* but the characteristics of the lower jaw, the rising sagittal region in No. 1, and the whole shape of No. 2, barring the supraorbital arch, indicate a morphological advancement in the direction of the present type of man such as is not met with in other examples of *Homo neanderthalensis.* The crania, and particularly No. 2, may be justly regarded, it seems, as approaching transitional forms from the more typical older Neanderthal type toward that which we now know from the Aurignacean and perhaps lower Solutrean epochs, such as the *Homo aurignacensis* and the man of Předmost.

Remarks on other skeletal parts from the Spy terrace will be limited to those of skeleton No. 2, the parts representing skeleton No. 1 being fewer in number and for the most part very defective. The bones of No. 2 are massive and show many primitive features, in which they approach closely to the skeleton from the Neanderthal cave. The femur is equally characterized by very stout neck and large head, the popliteal space is still slightly convex from side to

[1] Approximately. [2] Fragment.

Smithsonian Report, 1913.—Hrdlička. PLATE 22.



THE LOWER JAW OF SPY SKULL NO. 1.
(After Fraipont and Lohest.)

side. There is no isolated suprapatellar fossa as in the Neanderthal femur, but the ordinary lower suprapatellar depression is very pronounced. The curvatures of the femur, the characteristics of its condyles, and the marked backward inclination of the internal condyle of the tibia, differ all more or less from similar features in modern man and indicate habits of posture that have since been abandoned. The right femur (left broken) measures in bicondylar length 42.4 cm., in maximum length, 42.6; while the relatively short left tibia measures, less the spine, 33.3 cm. These dimensions correspond according to Manouvrier's tables to the stature of 161.1 cm. for the femur and 157 cm. for the tibia, or about 159 cm. (a little over 5 feet 3 inches) for the two bones together. The right femur of the Neanderthal skeleton, measured in the same manner, gave the writer 43.7, the left 43.9 cm., which shows that the Spy man was in all probability somewhat shorter. Prof. Boule, in his Annales de Paleontologie, (vol. 7, 1912, p. 117), estimates the stature of the Spy man as identical (or 1 millimeter higher) with that of the Neanderthal man, but this is evidently based on erroneous data concerning the length of the bones. However, even the most precise estimates in this line can only be gross though useful approximations, for we know but little of the length of the trunk in these skeletons, and the posture of the body in the early representatives of humanity was probably less erect than it is in man to-day.

The remaining bones of the Spy skeletons show various anatomical peculiarities and secondary primitive features, but these call for a technical description and comparisons. A rather unexpected condition, found since in other skeletons of *Homo neanderthalensis*, is the relative shortness of the forearms, as well as the legs. The radius shows a marked nonpathological curvature; and there are a number of interesting characteristics on the astragalus, which has recently been studied with much detail by the son of Julien Fraipont.[1]

The region that has given us the Spy skeletons has yielded no additional remains of similar nature, but the terrain can scarcely be regarded as exhausted by exploration.

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[1] The following works may be consulted in this connection:
Julien Fraipont et M. Lohest, Recherches sur les ossements humains découverts dans les dépôts quaternaires d'une grotte à Spy et détermination de leur âge géologique. Archives de biologie, tome 6, Gand. 1887; Fraipont, J.—Le tibia dans la race de Neanderthal. Revue d'anthropologie, Paris, 3d series, vol. 3, 1888, p. 145 et seq. Klaatsch, H.—Erg. d. Anat. u. Entwickelungsgesch, Bd. 9, 1899—Derselbe, Die wichtigsten Variationen am Skelett der freien unteren Extremität des Menschen und ihre Bedeutung für das Abstammungsproblem. ibid., Bd. 10, 1900; Fraipont, Charles—L'astragale de l'Homme Moustérien de Spy; ses affinités. Bulletin de la Société d'Anthropologie de Bruxelles, vol. 31, 1912, pp. 1–30, 3 pls.; do.—Sur l'Importance des caractères de l'astragale chez l'Homme fossile. Thèse, Univers. de Liège, 8°, Bruxelles, 1913, pp. 1–66, 6 pls.

THE DILUVIAL MAN OF KRAPINA.

One of the most important finds relating to the *Homo neanderthalensis* is unquestionably that of the Krapina cave, in northern Croatia. It comprises a whole series of human bones of well-determined age, and the remains were not recovered accidentally or by ignorant laborers, but through prolonged, painstaking exploration. The bones themselves are for the most part fragmentary, which is much to be regretted, but they represent numerous individuals, and they show on one hand such similarities and on the other such variation of

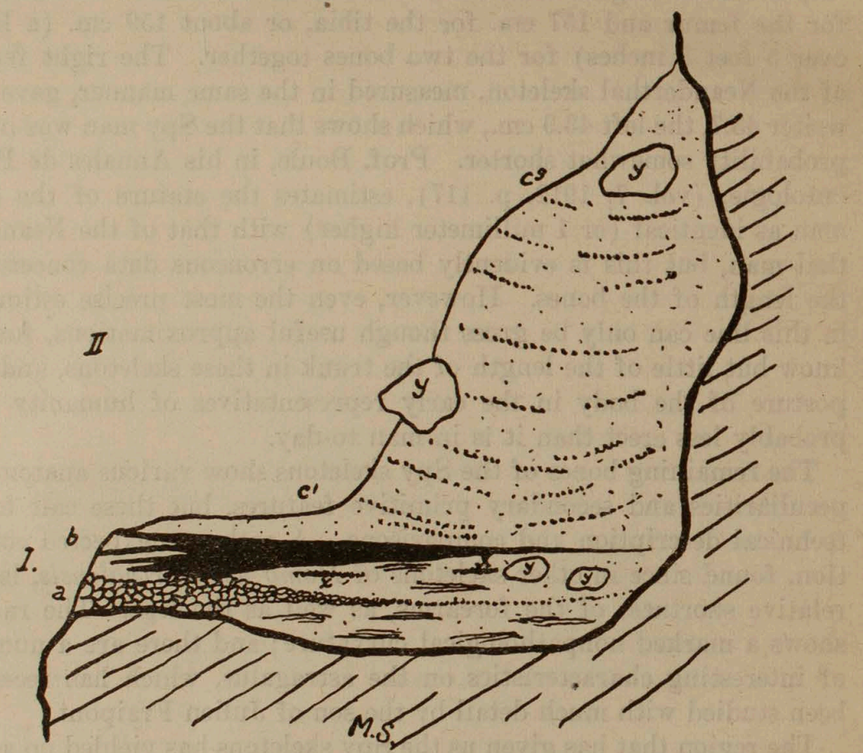


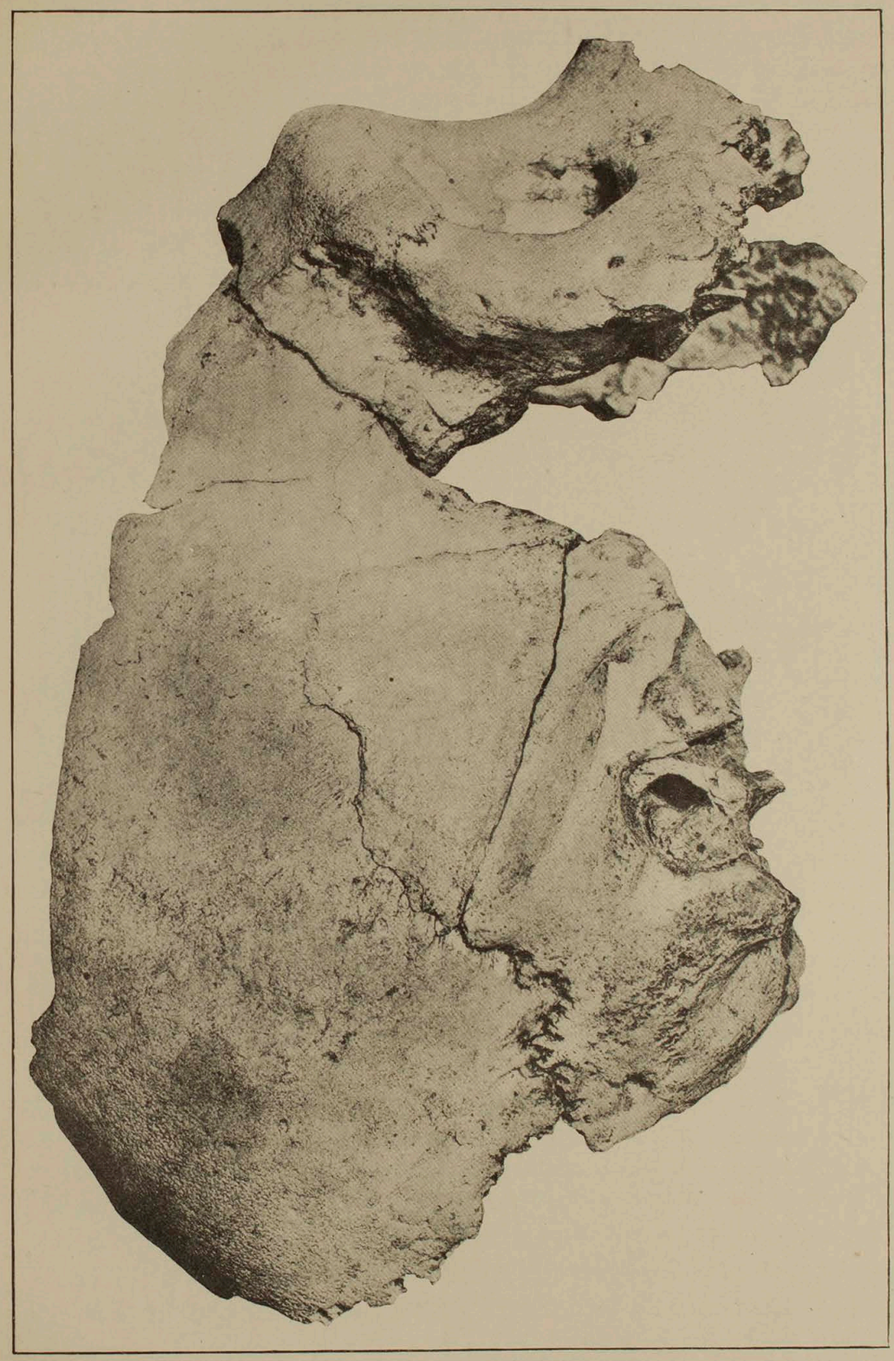
FIG 7.—A SCHEMATIC VIEW, IN TRANSVERSE SECTION, OF THE KRAPINA HOLLOW. (After Gorjanović Kramberger.)

M. S. = Mediterranean sandstone: I, the lower deposits, mostly pebbles (a) and aluvium (b), with fireplaces (x) and some large pieces of sandstone (y); II, the upper strata, composed of disintegrated rock and (c^1, c^2) cultural remains.

structure, that they are of the greatest value to the student of ancient humanity.

The Krapina cave or more properly rock shelter, is an ancient, not very deep hollow, worn out in sandstone rock by the small stream Krapinica, and subsequently filled with water-worn stones and aluvia brought in during overflows of the stream, together with detritus resulting from the decomposing rock (fig. 7). Since the formation of the hollow, the Krapinica has cut its channel so that it now

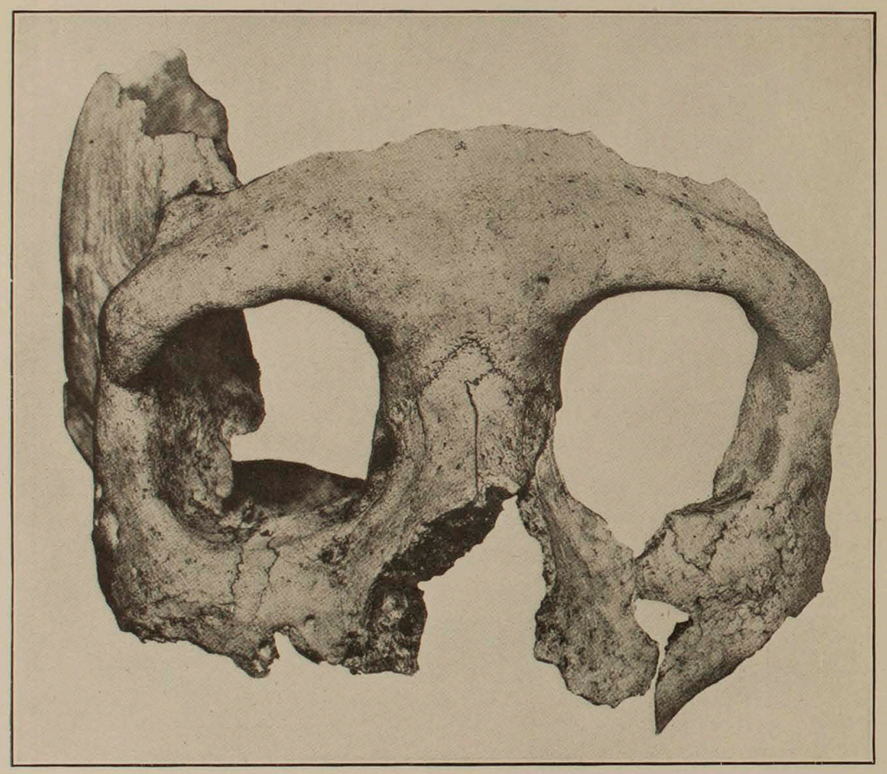
PLATE 23.



KRAPINA SKULL "C." SIDE VIEW.
(After Gorjanović-Kramberger.)

Smithsonian Report, 1913.—Hrdlička.

Smithsonian Report, 1913.—Hrdlička. PLATE 24.



KRAPINA SKULL "C." FRONT VIEW.

(After Gorjanović-Kramberger.)

flows 82 feet (25 meters) below the cave. Before and while the shelter was being filled up it was utilized by the early man of the region, at first but occasionally, later for some time perhaps continuously, and the accumulations in the cave were augmented by the remains of fireplaces, by refuse including many primitive stone implements and rejects as well as animal bones, and also by numerous human bones in more or less fragmentary condition.

The locality became known in 1895, after two Croatian teachers discovered in the superficial deposits of the cave some teeth of rhinoceros and fragments of other fossil bones. These finds were brought to the attention of some of the scientific men at Zagreb (Agram), but no thorough examination of the site was undertaken until 1899. In that year the place was visited by Dr. K. Gorjanović-Kramberger, professor of geology and paleontology in the University of Zagreb and the director of the geological division of the Narodni Muzej of Zagreb, Croatia; and on excavation it was soon found that the Krapina hollow was in all probability one of the stations of early man and as such deserved a thorough exploration. Such exploration was begun without delay and was carried on, with some interruptions, until 1905, when the contents of the shelter became exhausted.

The careful explorations just referred to yielded quantities of precious paleontological and paleoanthropological material, which now fill several cases of the National Croatian Museum; and much of this material has since been thoroughly described by Prof. Gorjanović-Kramberger and reported in numerous publications.[1]

The collections consist of several thousands of various fossil animal bones, mostly fragmentary, but some well preserved; of hundreds of stone flakes the rejects of stone manufacture, and of stone implements; and of parts of human bones proceeding from at least 14 skeletons.

The animal bones represent either totally extinct forms or species now extinct in Croatia. The most common are those of *Rhinoceros Merckii*, *Ursus spelaeus*, and *Bos primigenius*. By these remains the age of the deposits has been determined as earlier Diluvial (i. e. *interglacial*), corresponding in all probability to the latter part of the Mousterian culture epoch in western Europe. The stone implements belong to the Mousterian and earlier types.

Due to the courtesy of Prof. Gorjanović-Kramberger and Dr. F. Šulje, of the Geological Division at the Narodni Muzej in Zagreb, the writer was privileged, in June, 1912, to examine the Krapina originals. This was not done with any need or hope of adding any-

[1] Particularly in the large monograph, by K. Gorjanović-Kramberger: "Der Diluviale Mensch von Krapina in Kroatien," 4°, Wiesbaden, 1906, pp. 1–277, 52 figs., 14 pls. This memoir includes all literature on the subject up to 1906.

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thing to Prof. Gorjanović-Kramberger's thorough description of the specimens, but rather because the view and handling of the original objects in a case of this importance is a rare treat which helps to fix in the mind, more than any description could, their extraordinary characteristics.

The human bones are, for the most part, in fragments. Notwithstanding their defective condition, however, the collection impresses the student most forcibly by its scientific importance. As in the case of the Mauer jaw and a number of other specimens derived from early man in Europe, the material bears the unmistakable stamp of genuineness and preciousness to anthropology, impressions which are wanting in the case of so many of the finds that are merely urged as ancient.

The bones represent, as already mentioned, the remains of at least 14 individuals of both sexes, ranging from childhood to ripe adult age. The fragmentation of the skulls (pls. 23–25) lower jaws and some of the long bones is excessive, and of such a nature as to suggest that it was caused otherwise than by accidental breaking or crushing. A number of the fragments show also the effects of burning, and one specimen, a portion of the supraorbital part of a frontal, presents some cuts. These different conditions, together with the absence of many parts of the skulls and bones, with total lack of association of the fragments and the commingling of the human with the animal bones, led Gorjanović-Kramberger to the opinion that the remains represent the leavings of occasional cannibalistic feasts and are not burials.

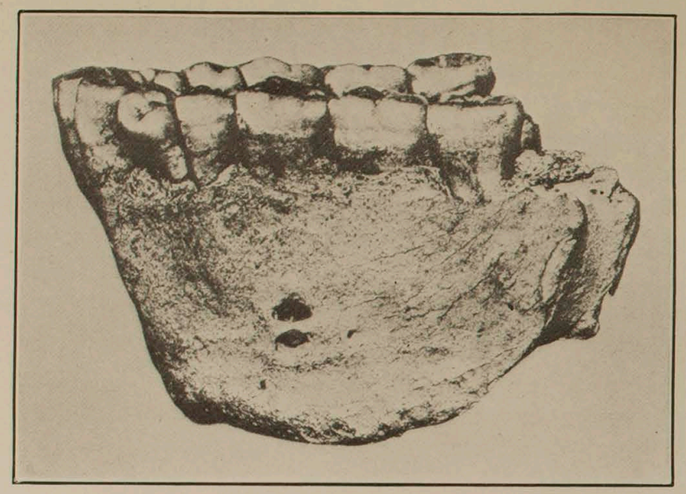
The Krapina bones are whitish, yellowish, or light brownish in color. They are not of great weight, but a chemical examination has shown that they are much altered in constitution, particularly in the fluorine-phosphates proportions. They may be roughly divided into the parts representing the vault of the skull; the jaws and the teeth; and other bones of the skeleton than the cranium.

The long and other bones of the skeleton, relatively less interesting than the skulls and jaws, show the Krapina man to have been, as compared with central European white man of to-day, of moderate stature, and outside of the powerful jaws, of strong though not excessive muscular development. Some individuals were very perceptibly weaker than others. As to form, particularly in the upper extremities, the bones in general are perceptibly more modern in type than those of the Neanderthal or Spy man, nevertheless they present, as well shown by Prof. Gorjanović-Kramberger, numerous and important primitive features.

The fragments of the skulls show that the bones of the vault were considerably thicker than they are in the white man of to-day. The crania were of good size externally, but the brain cavities were prob-

Smithsonian Report, 1913.—Hrdlička. PLATE 25.

PHOTOGRAPH OF THE REMAINS OF KRAPINA SKULL "C," FROM ABOVE.
(After Gorjanović-Kramberger.)



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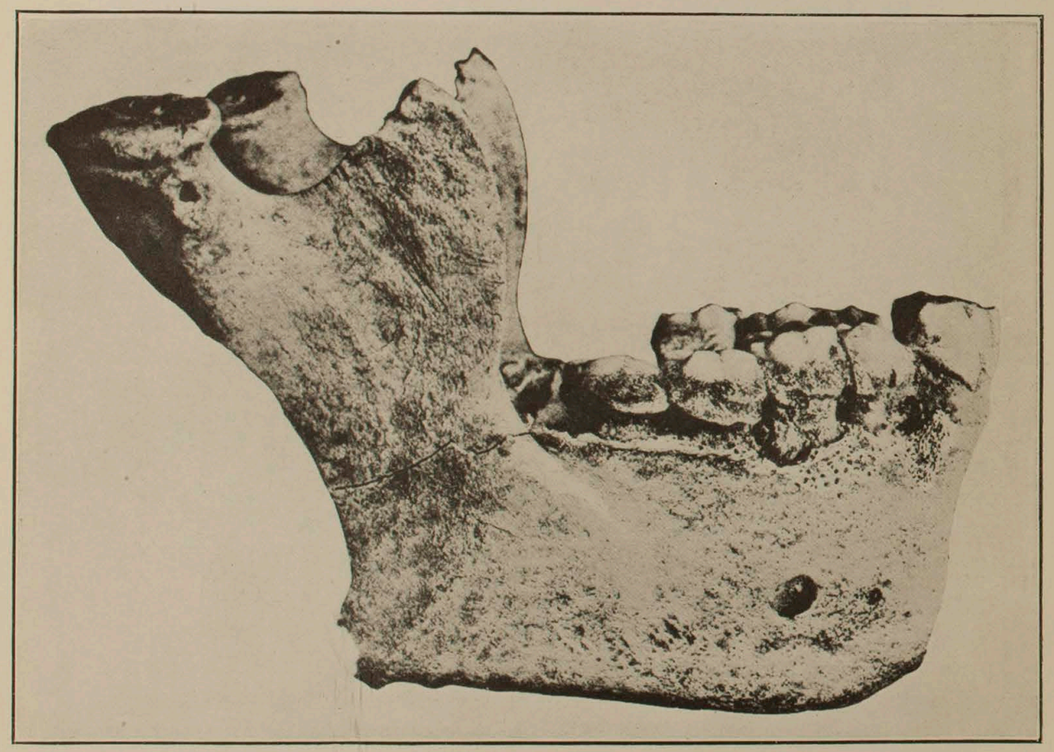
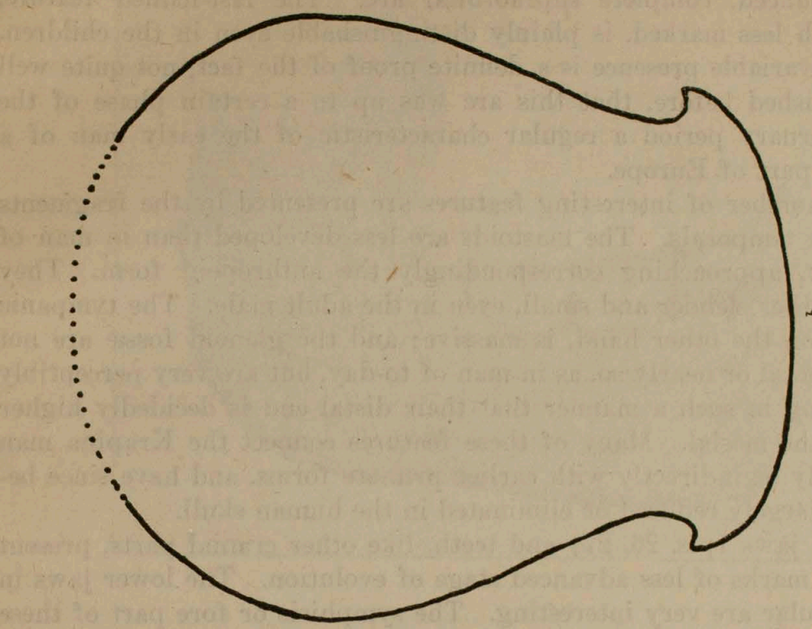


b

a. KRAPINA LOWER JAW "H." *b*. KRAPINA LOWER JAW "I."
(After Gorjanović-Kramberger.)

ably below the present average. The vault of the skull was of good length and at the same time fairly broad, so that the cephalic index,



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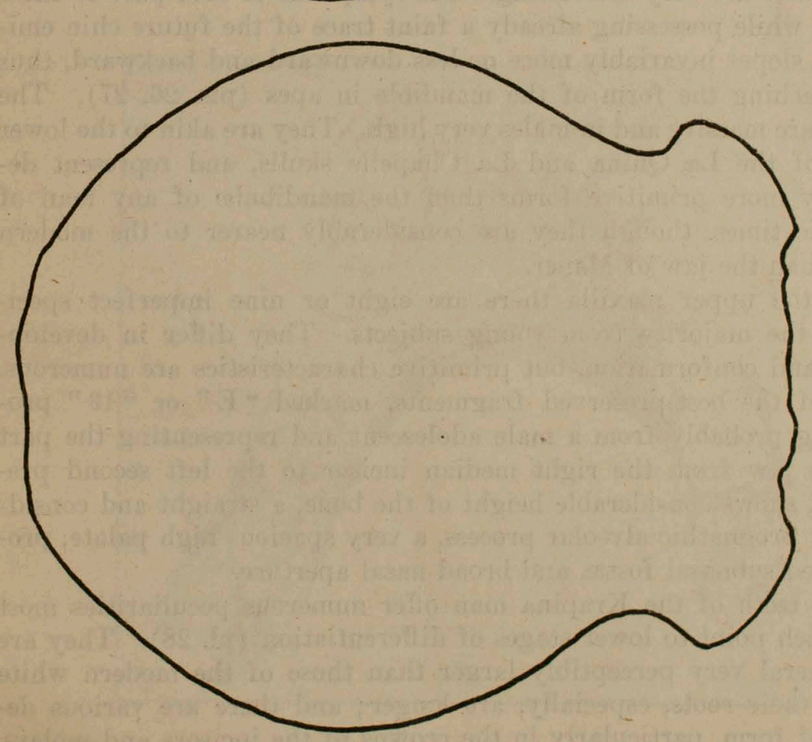


a

FIG. 8.—*a*, OUTLINE OF KRAPINA SKULL "*D*" (RECONSTRUCTED) AS SEEN FROM ABOVE. *b*, OUTLINE OF KRAPINA SKULL "*C*" (RECONSTRUCTED) AS SEEN FROM ABOVE. (After Gorjanović-Kramberger.)

at least in some of the individuals, was more elevated than usual in the crania of early man (fig. 8). They were also characterized, as the

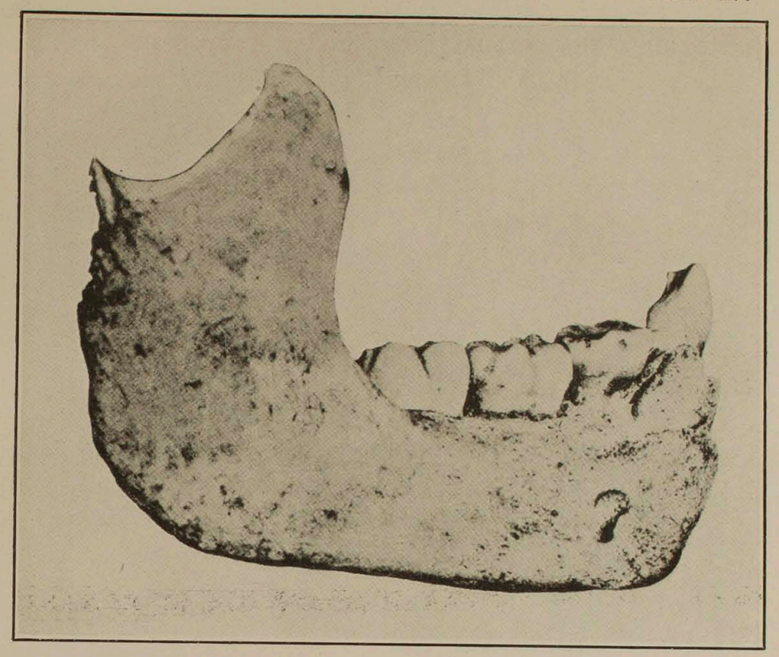
Neanderthal and other crania of the man from the Mousterian epoch, by lowness of the vault, and in every instance among the adults by a pronounced, complete supraorbital arc. The last-named feature, though less marked, is plainly distinguishable even in the children. Its invariable presence is a definite proof of the fact, not quite well established before, that this arc was up to a certain phase of the Quaternary period a regular characteristic of the early man of a large part of Europe.

A number of interesting features are presented by the fragments of the temporals. The mastoids are less developed than in man of to-day, approaching correspondingly the anthropoid form. They are rather slender and small, even in the adult male. The tympanic ring, on the other hand, is massive; and the glenoid fossæ are not horizontal or nearly so, as in man of to-day, but are very perceptibly slanting in such a manner that their distal end is decidedly higher than the mesial. Many of these features connect the Krapina man directly or indirectly with earlier primate forms, and have since become largely reduced or eliminated in the human skull.

The jaws (pls. 26, 27) and teeth, like other cranial parts, present many marks of less advanced stage of evolution. The lower jaws in particular are very interesting. The symphisis or fore part of these bones, while possessing already a faint trace of the future chin eminence, slopes invariably more or less downward and backward, thus approaching the form of the mandible in apes (pls. 26, 27). The bones are massive and in males very high. They are akin to the lower jaws of the La Quina and La Chapelle skulls, and represent decidedly more primitive forms than the mandibulæ of any man of historic times, though they are considerably nearer to the modern type than the jaw of Mauer.

Of the upper maxilla there are eight or nine imperfect specimens, the majority from young subjects. They differ in development and conformation, but primitive characteristics are numerous. One of the best-preserved fragments, marked "E" or "19" proceeding probably from a male adolescent and representing the part of the jaw from the right median incisor to the left second premolar, shows considerable height of the bone, a straight and considerably prognathic alveolar process, a very spacious high palate, pronounced subnasal fossæ, and broad nasal aperture.

The teeth of the Krapina man offer numerous peculiarities most of which point to lower stages of differentiation (pl. 28). They are in general very perceptibly larger than those of the modern white man; their roots, especially, are longer; and there are various details of form, particularly in the crowns of the incisors and molars, some of which are related to anthropoid features. Notwithstanding these facts, the Krapina teeth, and particularly the canines, are on the whole relatively near those of present man.



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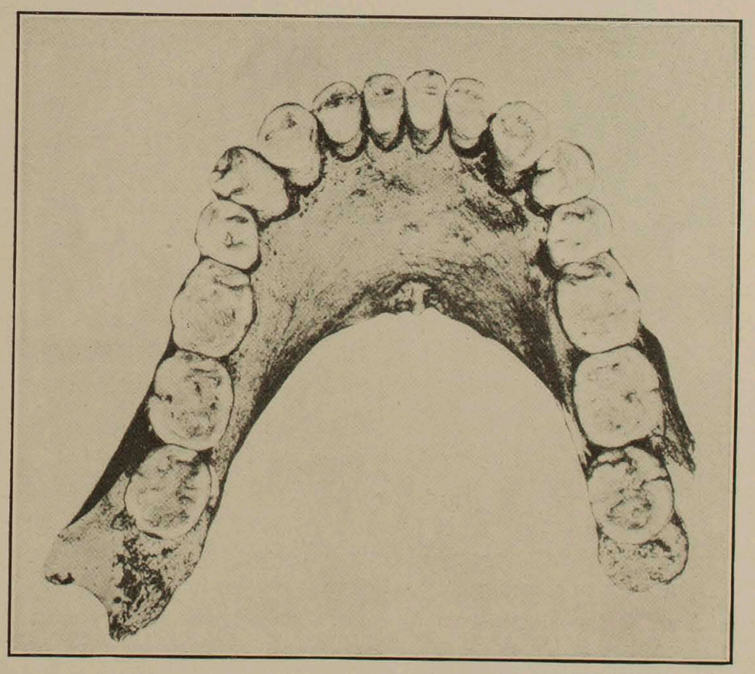
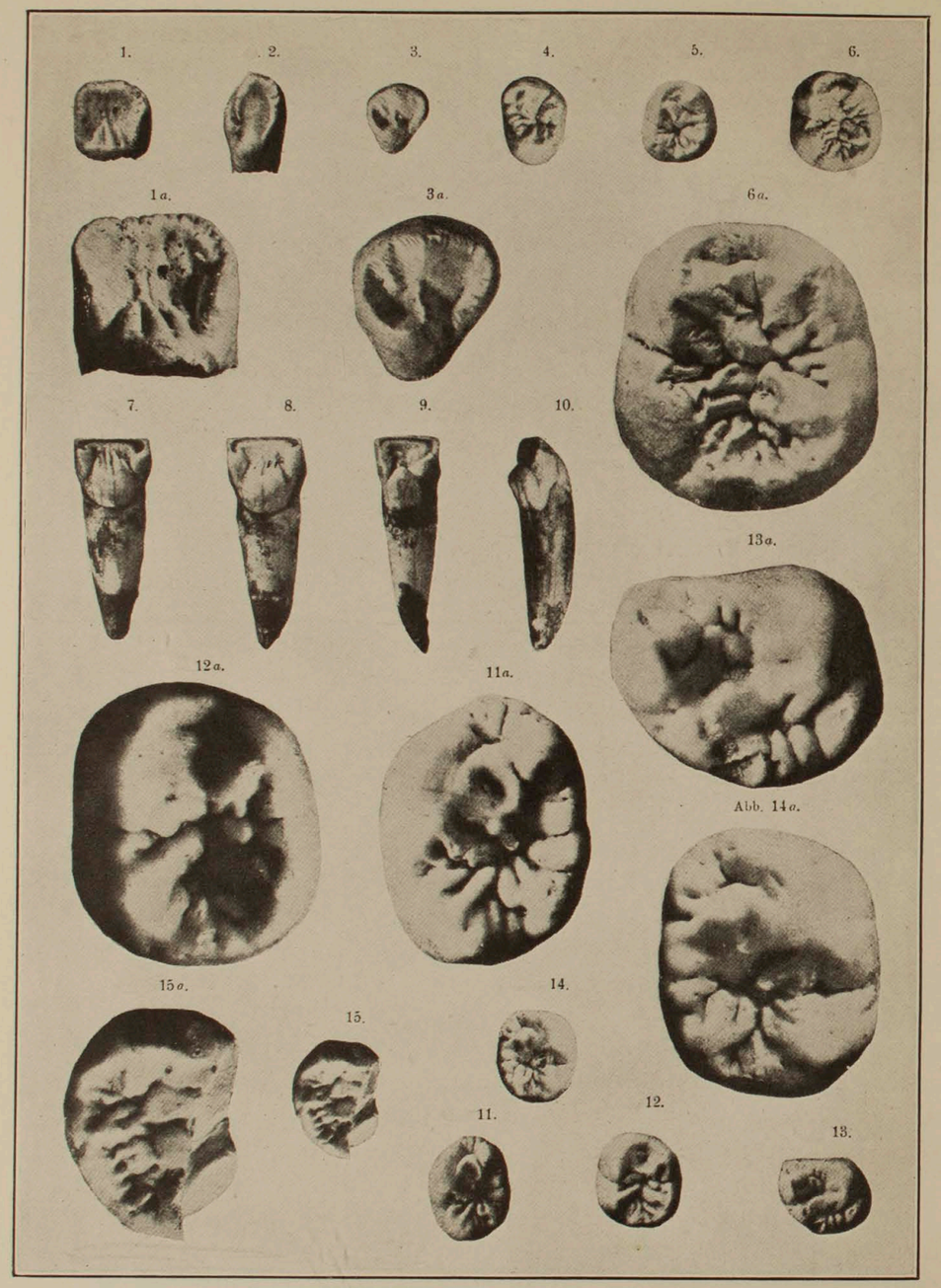


b

a. KRAPINA LOWER JAW "H," FROM APPROXIMATELY A 13-YEAR-OLD CHILD.
b. KRAPINA LOWER JAW "C," FROM ABOVE.

(After Gorjanović-Kramberger.)



A NUMBER OF THE KRAPINA TEETH, MORE OR LESS ENLARGED.

1, permanent median upper incisor from a small child; 1a, the same, greater enlargement; 2, permanent upper canine, root not as yet fully developed; 3, permanent anterior lower premolar, right side; 3a, the same in greater enlargement; 4, permanent second (?) upper molar; 5, permanent lower left second molar; 6, permanent left lower first molar; 6a, the same, much enlarged; 7, permanent upper median incisor, edge worn off; 8, the same; 9, lateral upper permanent incisor; 10, the same; 11, a third permanent molar; 11a, the same in greater enlargement; 12, the left lower permanent second molar; 12a, the same much more enlarged; 13, the right permanent second molar; 13a, the same in greater enlargement; 14, a third permanent molar; 14a, the same in greater enlargement; 15, a permanent third molar; 15a, the same. (From Gorjanović-Kramberger Mitth. Anthrop. Ges. Wien XXXI.)

Taking everything into consideration, it is evident that the diluvial man of Krapina represents a group belonging to the family of the *Homo neanderthalensis*. He is very ancient and in many respects anatomically primitive, though he also shows in various details an advancement toward the actual human form; and we can readily adopt Prof. Gorjanović-Kramberger's opinion that morphologically the Krapina man is not any special, collateral, and extinct branch of the genus *Homo*, but more probably a direct and not excessively far distant ancestor of the *Homo sapiens*.

THE PLEISTOCENE MAN OF JERSEY (ENGLAND).

In 1910 Messrs. Nicolle and Sinel, of the Island of Jersey, gave notice in *Man* and in a bulletin of the Jersey Society,[1] of the discovery in an old cave on the Island of Jersey of twelve highly interesting human teeth, belonging to a man of the Mousterian epoch. The principal details of the find, according to the clear account presented by the two authors and confirmed by the writer's observations on the spot, are as follows:

The cave where the ancient human remains were found is known as La Cotte, or La Cotte de St. Brelade, and is situated in a rough irregular cliff near the eastern horn of St. Brelade's Bay, Jersey. At this part of the island granite rocks, considerably weathered and broken, rise steeply to about 200 feet above mean tide level, the shore at their base being covered with accumulations of large, rounded, waterworn bowlders (pls. 29–31).

In one part of these cliffs there is an irregular rough ravine or gorge, about 40 feet in width, which penetrates inland about 150 feet. The side walls of this ravine are, in a large part, quite vertical, and in the base of these walls on the left, near the upper terminus of the gorge, is a large cave which bears the above name.

Before its exploration, the La Cotte cave was nearly filled by clay, bowlders, and blocks fallen from the much-weathered roof, and rubble drift in the form of a steeply sloping talus lay in front, obscuring a large portion of the mouth. Removal of this drift revealed the outline of the opening in the form of an irregular arch (pl. 31).

The first indication that the cave had once been utilized by man dates from 1881, when two local naturalists, while "geologizing" on that part of the coast, found a flint implement at the foot of the talus, and, tracing its source, came upon a slightly exposed section of the cave floor. There they found flint chippings, and one or two bones, apparently of a large bird, but no importance was attached to the discovery. About 1894, two members of the Société Jersiaise,

[1] Nicolle, E. T., and J. Sinel. Report on the exploration of the palaeolithic cave dwelling known as La Cotte, St. Brelade, Jersey. (Man. vol. 10, 1910, No. 102, pp. 185–188. Reprinted in 36e Bulletin de la Société Jersiaise, Jersey, p. 69.)

Mr. R. Colson and Dr. Chappuis, excavated a portion of the exposed floor section of the cave and found a considerable number of flint implements and besides that a quantity of bone breccia, which contained one tooth and one metatarsal of a variety of horse.

Subsequently various partial examinations of the accumulations in the cave resulted in the discovery of implements, and of a large number of flint chippings. All these are preserved in the Museum of the Société Jersiaise, at St. Helière.

In September, 1905, finally, the Jersey Society decided to explore the cave systematically, and Dr. Chappuis, Mr. Nicolle the secretary, and Mr. Colson, commenced work in that part of the exposed floor already mentioned. More flint implements were discovered, but at the commencement of October the work had to be abandoned owing to the rainy season and to the fact that the explorers were excavating under dangerous conditions. It then became clear that a considerable portion of the talus as well as some of the threatening rocks overhead had to be removed before the work could proceed.

Thus matters remained until July, 1910, when the society resolved to make another attempt at the exploration of the cave. With the help of experienced quarrymen excavation was commenced on August 1, and after a little over three weeks' work, sufficient of the rubble had been removed to reveal the form of the interior of the cave and to lay bare a portion of the floor about 11 feet square to the left of the entrance.

The dimensions of the cave as revealed at this stage were as follows: The entrance was 25 feet in height and about 20 feet in width. Just within, the roof sloped upward into a rough dome 30 to 32 feet from the floor. How far the cave entered the rock could not be ascertained, but judging from the slope of the roof downward towards the back, it was probably some 40 to 50 feet.

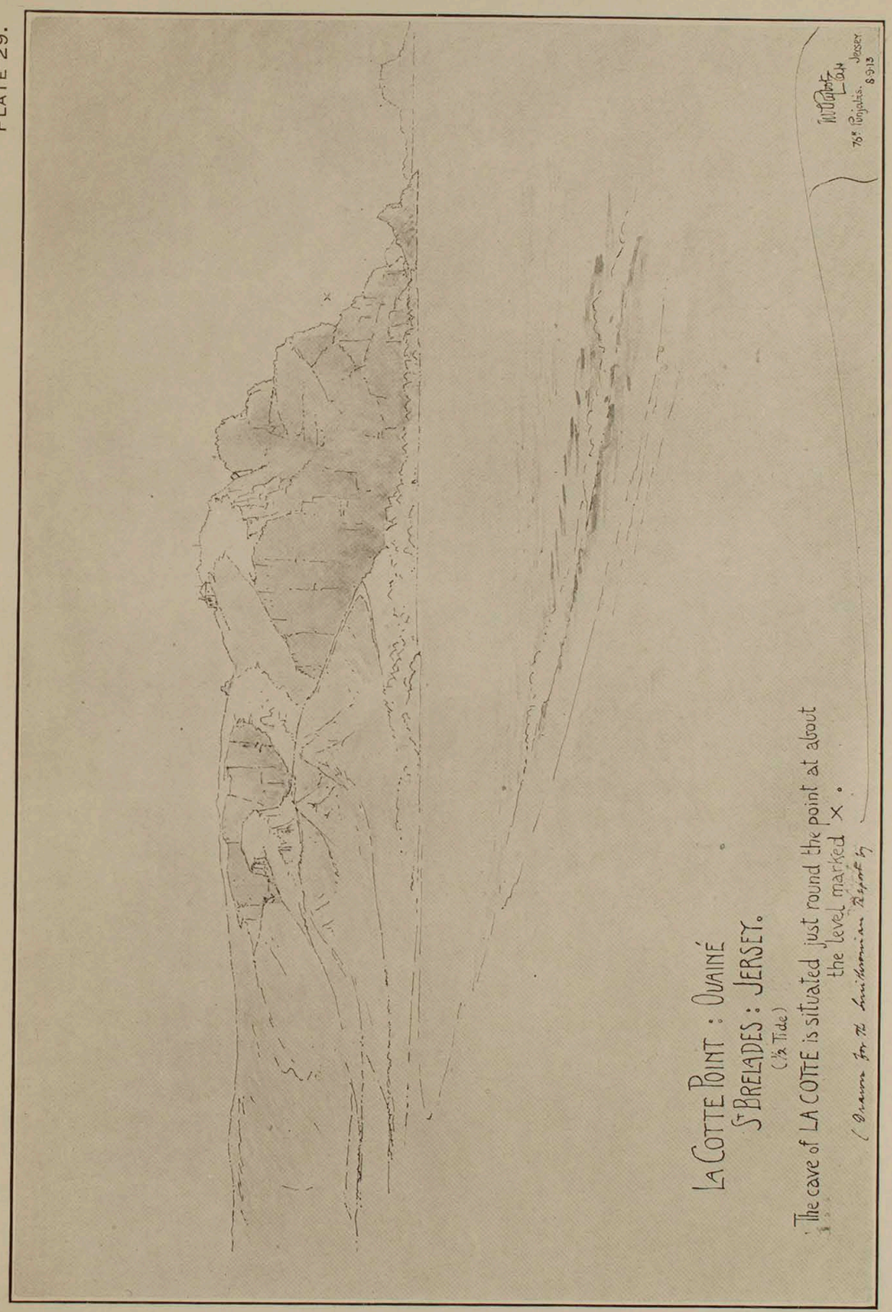
As soon as a portion of the floor had been reached a careful search and examination were commenced, with the following results:

The floor proper was not clearly marked, for layers of black soil, which proved to be a combination of ashes, carbonized wood and clay, were mixed up with whitish masses of bone detritus and clay compacted into breccia. Flint implements and chippings were interspersed plentifully throughout these deposits.

On the left of the entrance and at a distance from it of about 8 feet, was a hearth containing a quantity—probably a quarter of a ton or so—of wood ashes and carbonized wood. Close together, among the ashes of the hearth, were a few pebbles of granite and felsite bearing indications of having been heated.

The presence of bones was manifest all through the layers constituting the floor, but due to advanced decomposition of the material, the cave not being a dry one, only here and there could fragments

PLATE 29.


La Cotte Point : Ouaine
St Brelades : Jersey.
(½ Tide.)
The cave of LA COTTE is situated just round the point at about the level marked 'X'.
Drawn for the Smithsonian Report by

Smithsonian Report, 1913.—Hrdlička.

A DISTANT VIEW OF THE ROCKY PROMONTORY IN WHICH IS LOCATED THE CAVE THAT YIELDED REMAINS OF THE "HOMO BRELADENSIS."

PLATE 30.

A VIEW FROM SOME DISTANCE OF THE CAVE AT LA COTTE, ST. BRELADE, JERSEY, WHERE REMAINS OF THE "HOMO BRELADENSIS" WERE DISCOVERED.

Smithsonian Report, 1913.—Hrdlička.

retaining any form be obtained. Nevertheless, in one corner, at a slightly higher elevation than the earth, there was found a mass of bone from which some determinable portions could be secured; and a careful examination of this mass led to the most important result of the excavations to this time, namely, the discovery of nine human teeth. Three of these were from the upper, five from the lower jaw. They represent, as was later determined, teeth of both sides and of one individual, but unfortunately no trace of the once supporting bone was any more apparent.

All the bones and teeth recovered from the cave were taken to the British Museum for determination, and Drs. Woodward and Andrews identified the specimens as follows:

ANIMAL TEETH: Part of left lower premolar of the wooly rhinoceros, *Rhinoceros tichorhinus;* last premolar and first molar of reindeer, *Rangifer tarandus* (a large species apparently as large as the caribou); upper cheek teeth of a small species of *Horse;* parts of lower molars and upper cheek tooth of a large species of *Horse;* lower teeth in portion of jaw of one of small Bovidæ; and left incisor of *Bos*, Spec.?

NINE HUMAN TEETH, with subsequent recovery of four others.

BONES AND HORNS: Part of horn core of one of small Bovidæ; portion of antler of reindeer; bone, probably from articulation of foreleg of a deer; pelvic bones, probably from a small bovid; and a piece of bone, which fell to pieces on removal, from a rhinoceros.

Among the fragments that could not be definitely determined was apparently a portion of a human tibia.

Of flint instruments about 100 have been obtained. They are, without exception, of the well-known tongue-shaped Mousterian type, the "pointe a main" of Mortillet.

The cave gave no evidence of other than one occupation, and is thus probably free from the confusion which results when implements and remains of the fauna of different periods occur together and have become mixed by the work of burrowing animals, water during floods, and other agencies, as is often the case in similar deposits.

By their fauna and the uniform type of stone implements, the La Cotte cave deposits are shown clearly to be of the Mousterian epoch.

Further explorations of the site were carried on under the auspices of the Jersey Society in 1911 and again in 1912. They are reported by Nicolle and Sinel and by Marett.[1] They threw considerable light on the nature of the cave and its filling, and were extended to what

[1] Nicolle, E. T., and Sinel. Report on the resumed exploration of "La Cotte," St. Brelade, by the Société Jersiaise, 1911. (Man, vol 12, 1912, No. 88, pp. 158–162. Also in 37e Bulletin de la Société Jersiaise, 1912, pp. 213–222.)

Marett, R. R. Pleistocene Man in Jersey. (Archæologia, vol. 62, Oxford, 1911, pp. 449–480.)

Marett, R. R. Further observations on prehistoric man in Jersey. (Archæologia, vol. 63, 1912, pp. 1–28.)

Marett, R. R., and G. F. B. De Gruchy. Excavation of a further portion of La Cotte de St. Brelade. (38e Bulletin de la Société Jersiaise, 1913, pp. 326–330.)

may prove to have been a part of the same hollow on the base of the wall of the opposite side of the gorge ("la Cotte de St. Brelade II"—Marett). They resulted in the discovery in both caves of numerous additional flint implements, all of the Mousterian type, and in the older excavation of more fragments of animal bones, referable principally to the wooly rhinoceros, the reindeer, a large variety of horse, and probably the *Bos primigenius*. But no further human bones or teeth came to notice.

Meanwhile the human teeth (pl. 32) were subjected to careful examination by Prof. Keith, of the Royal College of Surgeons, and Mr. Knowles, of the Oxford University. The results of these studies were published in 1911 in the Journal of Anatomy and Physiology,[1] and later, with some additions, in the thirty-seventh bulletin of the Jersey Society. The following embraces the gist of these reports, as well as of the writer's own observations.[2]

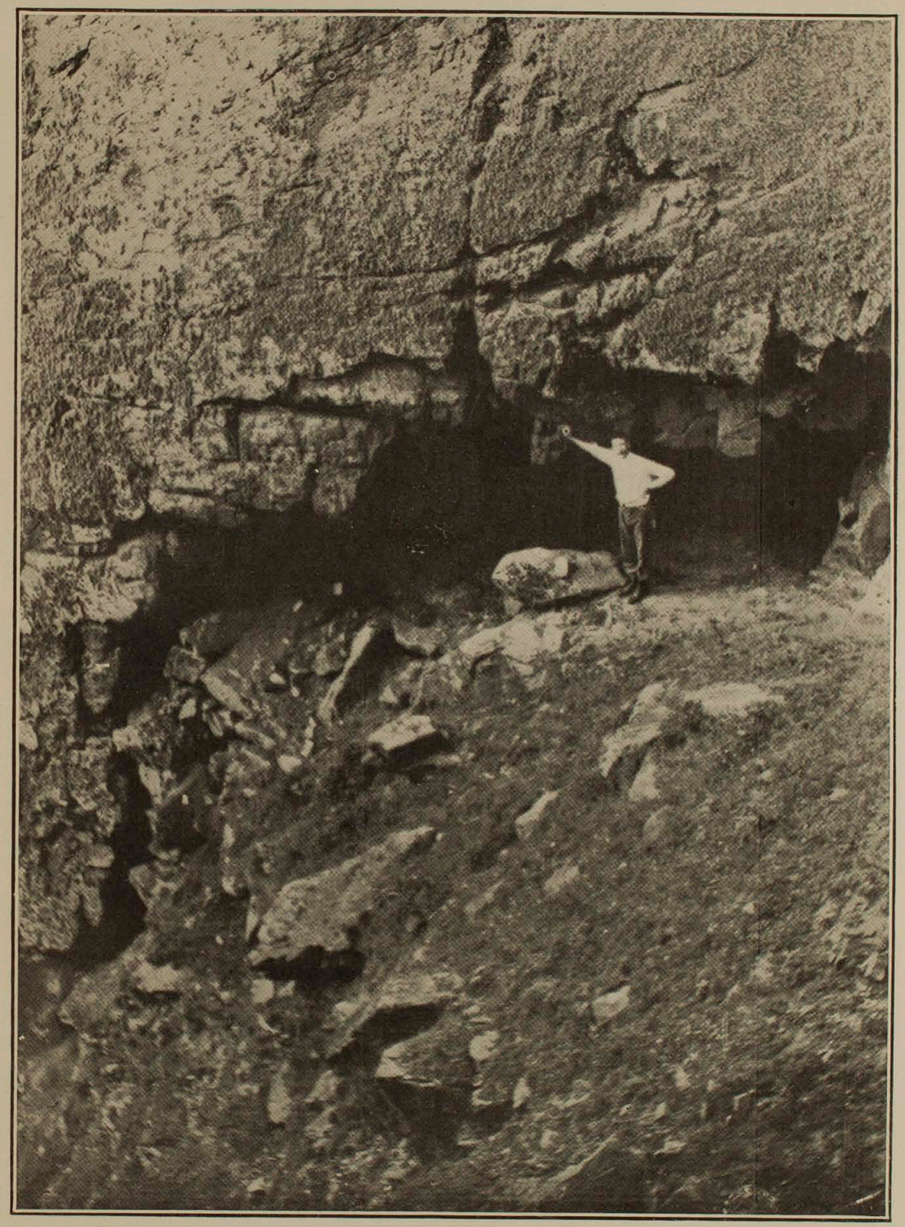
The teeth are in an unexpectedly good state of preservation, only the terminal parts of the roots being broken away. Their color is dark brown, with grayish white somewhat chalky looking crowns. All show an advanced degree of fossilization. The apices of the cusps were worn away in life and the finer architecture of the crown is as if faded, probably through corrosive action of the moisture in the deposits that enclosed the specimens.

Five of the teeth, namely a second left premolar, a first right and a second left molar, and the right and left third molar, with a part of the root of left incisor, belong to the upper jaw, while seven are from the lower jaw, being respectively a canine, first and second premolar with second molar of the left side, and a second incisor with second and third molars of the right side. All are probably from the same set and their characteristics are such that the ancient man they represent must be ranked anthropologically as one of the most primitive yet discovered.

The following illustration (pl. 33), shows a reconstruction of the upper and lower dental arches of the St. Brelade man, by Keith and Knowles, and the upper arch in the modern human skull, after Cunningham. It is seen at a glance that the Jersey teeth are larger than the modern in every direction and that in consequence the dental arches themselves must have been considerably larger.

[1] Keith, A., and F. H. S. Knowles. A description of teeth of paleolithic man from Jersey. (Journ. Anat. Physiol., London, vol. 46, 1911, pp. 12–27. Reprinted, with an additional note, in 37e Bulletin de la Société Jersiaise, 1912, pp. 223–240. Abstract in Nature, vol. 86, 1911, pp. 415–416.)

[2] In June, 1912, the writer visited Jersey to examine the originals of these teeth and to visit the cave where they were discovered, and he wishes to warmly thank Mr. Sinel and Dr. Dunlap for the courteous treatment and facilities which they extended to him on this occasion, as well as Captain Rybot, of the 76 Punjabis, for his service in furnishing excellent sketches of the locality.



THE COTTE DE ST. BRELADE FROM NEAR.

(From a photograph furnished the Smithsonian Institution by Dr. R. R. Marett, of Oxford.)

THE JERSEY TEETH.*

(From a photograph furnished to the Smithsonian Institution by Dr. R. R. Marett, of Oxford.)

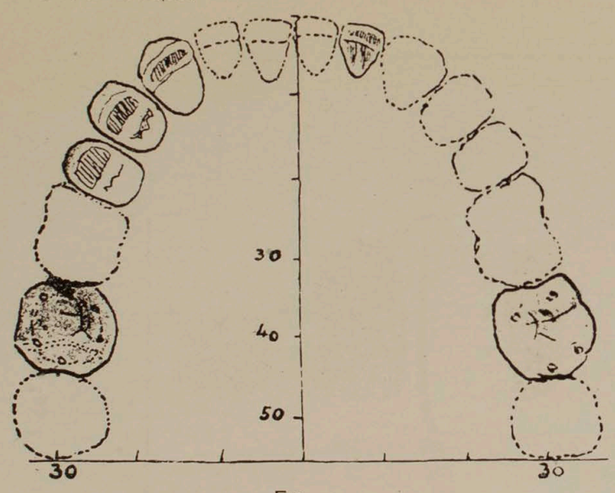


FIG. *a*

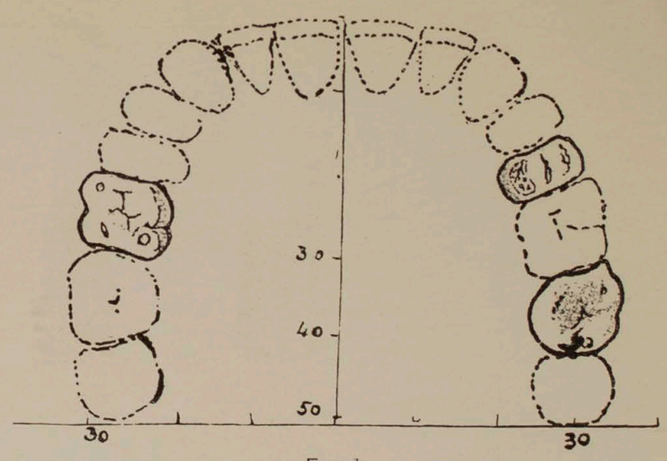


FIG. *b*

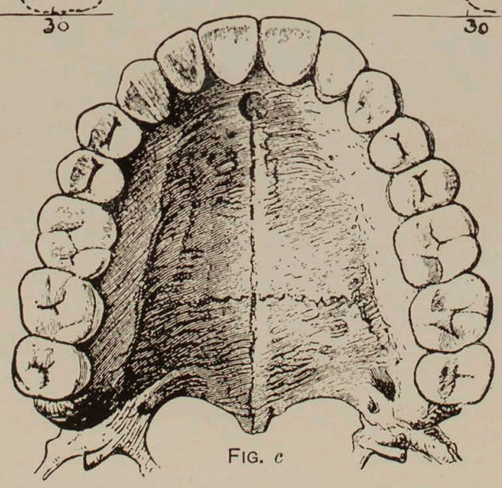


FIG. *c*

FIG. *a*.—TEETH OF LOWER JAW OF THE JERSEY MAN, PLACED IN THEIR PROBABLE POSITIONS, WITH RECONSTRUCTION OF LOWER ALVEOLAR ARCH. (AFTER KEITH.)
FIG. *b*.—TEETH OF THE UPPER JAW OF THE JERSEY MAN, IN THEIR PROBABLE POSITIONS, WITH RECONSTRUCTION OF THE UPPER ALVEOLAR ARCH. (AFTER KEITH.)
FIG. *c*.—MODERN UPPER DENTAL ARCH AND TEETH. (AFTER CUNNINGHAM.)

Another feature in which the Jersey teeth differ even more radically from the recent, is their extraordinarily stout roots. The diameters of the neck and roots of the Jersey teeth are almost equal to and in some cases exceed those of the crown, indicating that relatively great requirements were made on the teeth by the quality and possibly also quantity of the food. Such roots indicate unmistakably strong muscles of mastication and a stout massive lower jaw, probably somewhat smaller but scarcely less powerful than the still earlier Mauer mandible.

The roots of the Jersey premolars and molars are not only stout but they are also to a large extent fused. This is not an anthropoid feature, for in the higher apes these roots are well apart. The fusion is due to great development of the dentine and cement of the roots, brought about in this early man, in the opinion of Keith and Knowles, by a changed manner of mastication, characterized by more lateral besides vertical movements of the lower jaw. Other primitive features of the teeth are the early filling of the pulp cavities by deposits of dentine, thus providing an early adaptation for wear; the size and characters of the first premolars, which contrary to what occurs in present man are larger than the second bicuspids; and certain features of the canine as well as the molars.

Without going into more details, for which the reader will need to consult the originals—it may safely be concluded that the Jersey teeth constitute another valuable document of man's ancestry; and that they show an early man, probably an earlier representative of the *Homo neanderthalensis*, already quite advanced in denture from the prehuman forms, but still with teeth much more powerful as well as less specifically differentiated than those of present man.

The cave accumulations from which these teeth came are, fortunately, still far from exhausted which gives hopes of further important discoveries. The first cavern itself still presents a large accumulation of deposits that have not been explored, and, as mentioned above, there has been tapped a second cave in the rock opposite, while a communication between the two, as yet untouched, seems to lie behind the sagged-down rocks at the head of the ravine. The distant parts of these hollows in particular demands examination. The Société Jersiaise, under whose auspices the explorations of the site have hitherto progressed, will place the scientific world under especial obligation by carrying the work on with equal care to its conclusion.[1]

[1] Since this was written, a grant has been secured from the British Association for the Advancement of Science, by Dr. R. R. Marett, for further exploration of the cave, and in a recent letter to the writer Dr. Marett intimates that the work under this grant was not fruitless.

THE FOSSIL MAN OF LA CHAPELLE-AUX-SAINTS.

One of the most interesting, best authenticated, and thanks to Prof. Marcellin Boule now best-known skeletons of Early Man, is that of "the fossil man of La Chapelle-Aux-Saints.

La Chapelle-Aux-Saints is a small village in the Department of Corrèze, near the small railroad station of Vayrac and south of the town of Brive, in southern France. A little over 200 yards from the village and beyond the left bank of the small stream Sourdoire, in the side of a moderate elevation, is located a cave, now known as that of La Chapelle-Aux-Saints (pl. 34). In 1905 archeological exploration of this cave was undertaken by three Corrèze priests, the abbés A. and J. Bouyssonie and L. Bardon. These explorations which from the beginning were successful, resulting in the recovery of numerous industrial and other vestiges of paleolithic man, progressed gradually until the uniform archeological stratum was nearly exhausted, when, on the 3d of August, 1908, the excavators came across a shallow artificial fossa in the floor of the cave in which lay the bones of a remarkable human skeleton.

The human bones were carefully gathered and sent to Prof. Boule, of the Muséum d'Histoire Naturelle, in Paris, where they were cleaned and, as far as possible, restored; and the following December Prof. Boule demonstrated the skull, giving at the same time the first account of the find, before the Paris Academy of Sciences.[1] One week later Messrs. Bouyssonie and Bardon presented before the Academy their own observations, and these reports were followed at short intervals by several others before the same scientific body.[2]

Subsequently the skull and other parts of the skeleton were subjected by Prof. Boule to a thorough study and comparison, and the results of his work are published in a series of communications extending through the sixth, seventh and eighth volumes of the Annales de Paléontologie.[3]

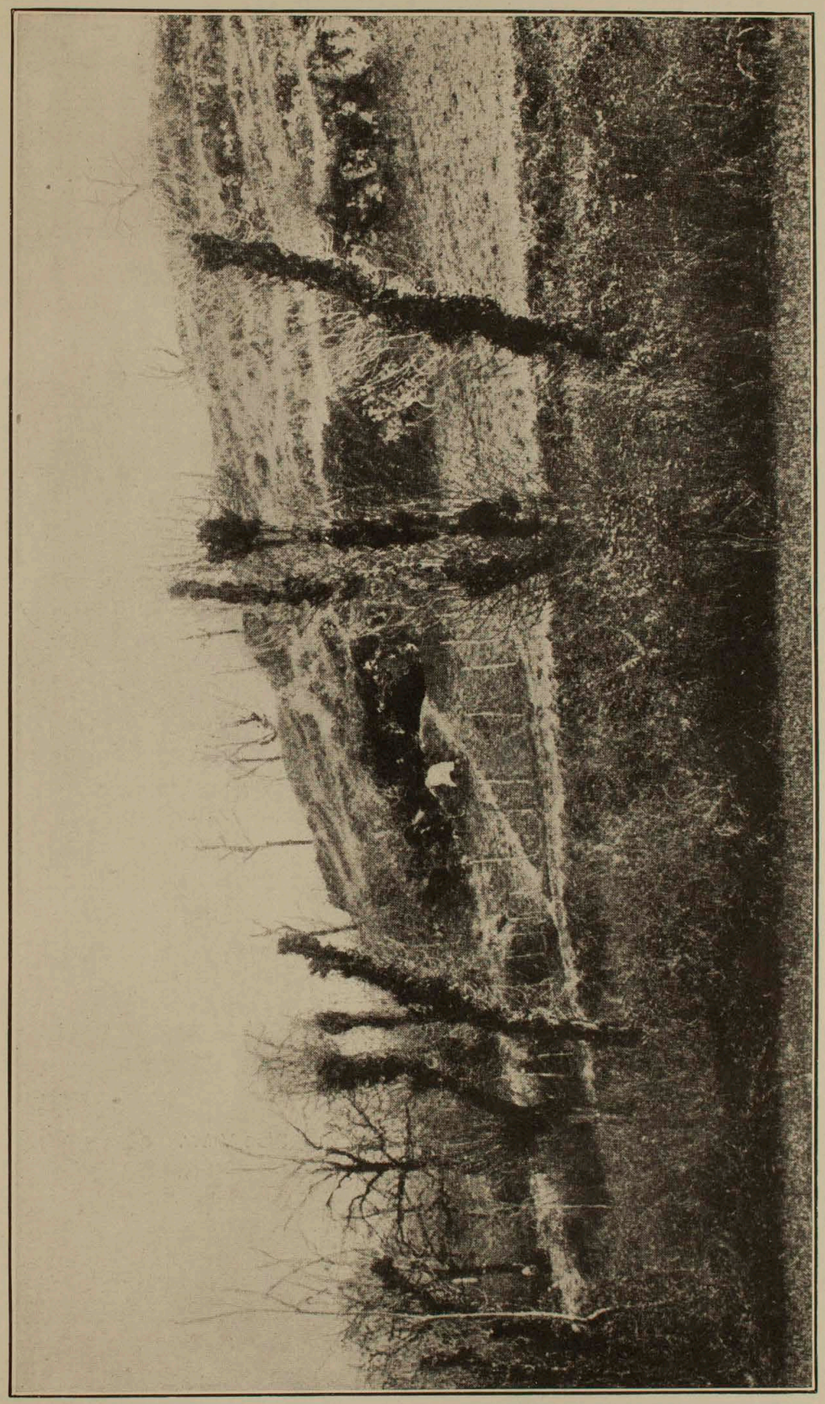
The various reports show that the cave of La Chapelle-Aux-Saints is a moderate-sized and rather low cavity, about 6 meters (6.5 yards) long, 2 to 4 meters (2.2 to 4.4 yards) broad, and 1 to 1.50 meters (1.1 to 1.6 yards) high (fig. 9). When first approached it was seen to be nearly filled with accumulations, which later disclosed numerous traces of man, and by débris of the rock from the roof and sides. The deposits bearing traces of the presence of man were found to

[1] Boule, M. L'Homme fossile de La Chapelle-Aux-Saints. (C. R. Acad. sc. 14 Dec., 1908; also L'Anthropologie vol. 19, 1908, pp. 513 and 519; vol. 20, 1909, p. 257; and vol. 22, 1911, p. 129.)

[2] Bouyssonie, A. J., and L. Bardon. Découverte d'un squelette humain moustérien à la bouffia de La Chapelle-Aux-Saints. (C. R. 21 Dec., 1908.) Boule, M. Sur la capacité cranienne des Hommes fossiles du type dit de Neanderthal. (C. R. 17 May, 1909.) La squelette du tronc et des membres de l'Homme fossile de La Chapelle-Aux-Saints. (C. R. 7 June, 1909.)

[3] Paris, 1911 to 1913. Also published as a separate volume.

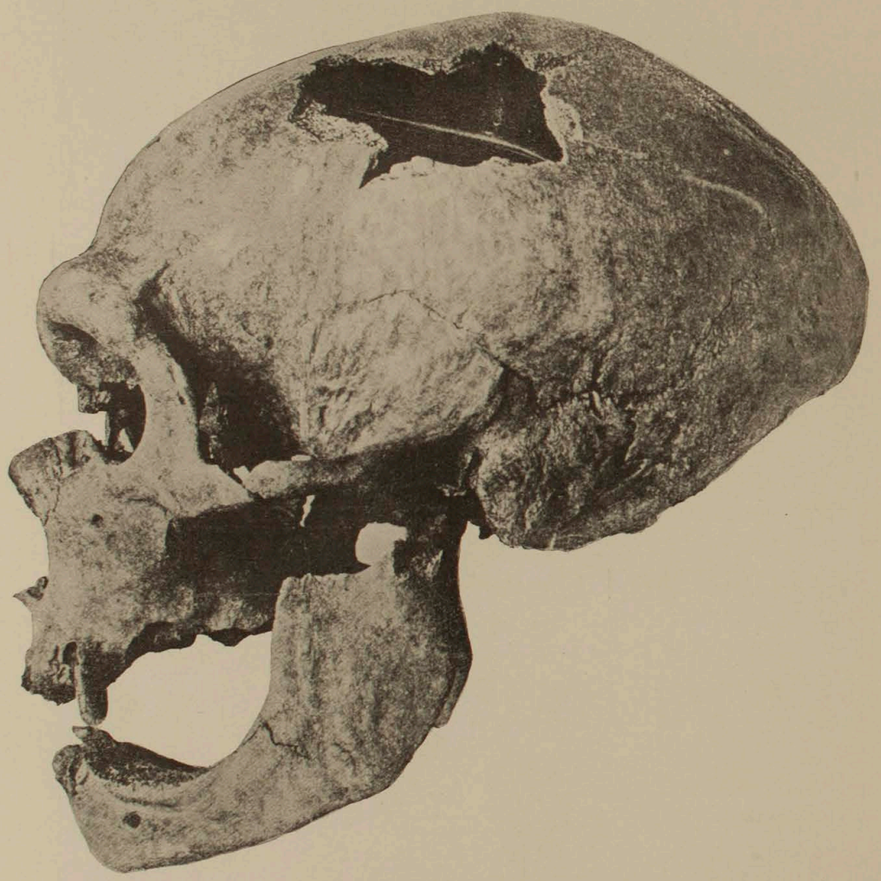
PLATE 34.



THE LA CHAPELLE-AUX-SAINTS CAVE.
(After Boule.)

Smithsonian Report, 1913.—Hrdlička.

Smithsonian Report, 1913.—Hrdlička. PLATE 35.



THE LA CHAPELLE-AUX-SAINTS SKULL. SIDE VIEW.

(After Boule.)

proceed from but one age and one culture, namely the Mousterian. The objects of archeological interest recovered during the excavation comprise in the main worked stones of the well-known Mousterian types, and remains of bones of fossil animals, such as the reindeer, bison, *Rhinoceros tichorhinus*, etc. The animal remains indicate that the deposits date from somewhere near the middle of the glacial epoch.

Under the accumulations the floor of the cavern was found to be whitish, hard, marly calcareous; and in this hard base, at the distance of a little over four meters from the entrance of the cave, was located the nearly rectangular, moderate-sized cavity[1] which lodged the fossil human skeleton. The depression was clearly made by the

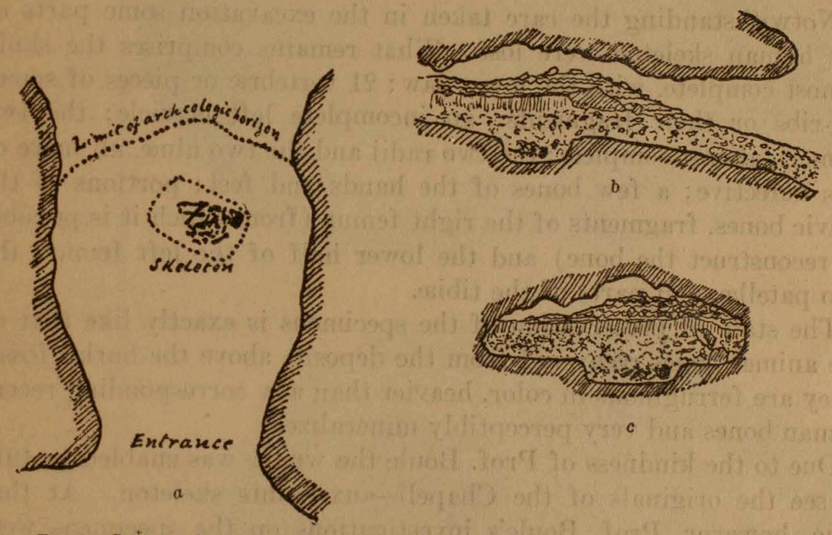


FIG. 9.—CAVE OF LA CHAPELLE-AUX-SAINTS. (After Bouyssonie & Bardon, and Boule.)
a, Floor; *b*, longitudinal section; *c*, transverse sections.

primitive inhabitants or visitors of the cave for the body and the whole represents very plainly a regular burial, the most ancient intentional burial thus far discovered.

The body lay on its back, with the head to the westward, the latter being surrounded by stones. The left arm was extended, the right probably bent so that the hand was applied to or lay near the head. The lower limbs were partly flexed. Above the head were found three or four large flat fragments of long bones of animals, and somewhat higher there lay, still in their natural relation, some foot bones of a large Bovid, suggesting that the whole foot of the animal may have been placed in that position. About the body were many

[1] 1.45 meters long, 1 m. broad, and 30 cm. deep.

flakes of quartz and flint, some fragments of ochre, broken animal bones, etc., much as in the rest of the archeological stratum above the skeleton.

There was no indication that the deposits in the cave have been moved in any way since the burial of the human body. To the right of the fossa containing the skeleton there was an abundance of large fragments of various animal bones, of jaws and vertebræ of the reindeer, and vertebræ of a large Bovid, with some well-made implements of flint. The last-named vertebræ and the flint implements were covered by two large blocks of stone; and above these stones, at the side wall of the cave, the earth showed the effects of fire, but it was not possible to determine whether this was of the same date as the deposits or the human burial beneath.

Notwithstanding the care taken in the excavation some parts of the human skeleton were lost. What remains comprises the skull, almost complete, with the lower jaw; 21 vertebræ or pieces of same; 20 ribs or their fragments; an incomplete left clavicle; the two humeri, almost complete; the two radii and the two ulnæ, all more or less defective; a few bones of the hands and feet; portions of the pelvic bones, fragments of the right femur (from which it is possible to reconstruct the bone) and the lower half of the left femur; the two patellæ, and parts of the tibiæ.

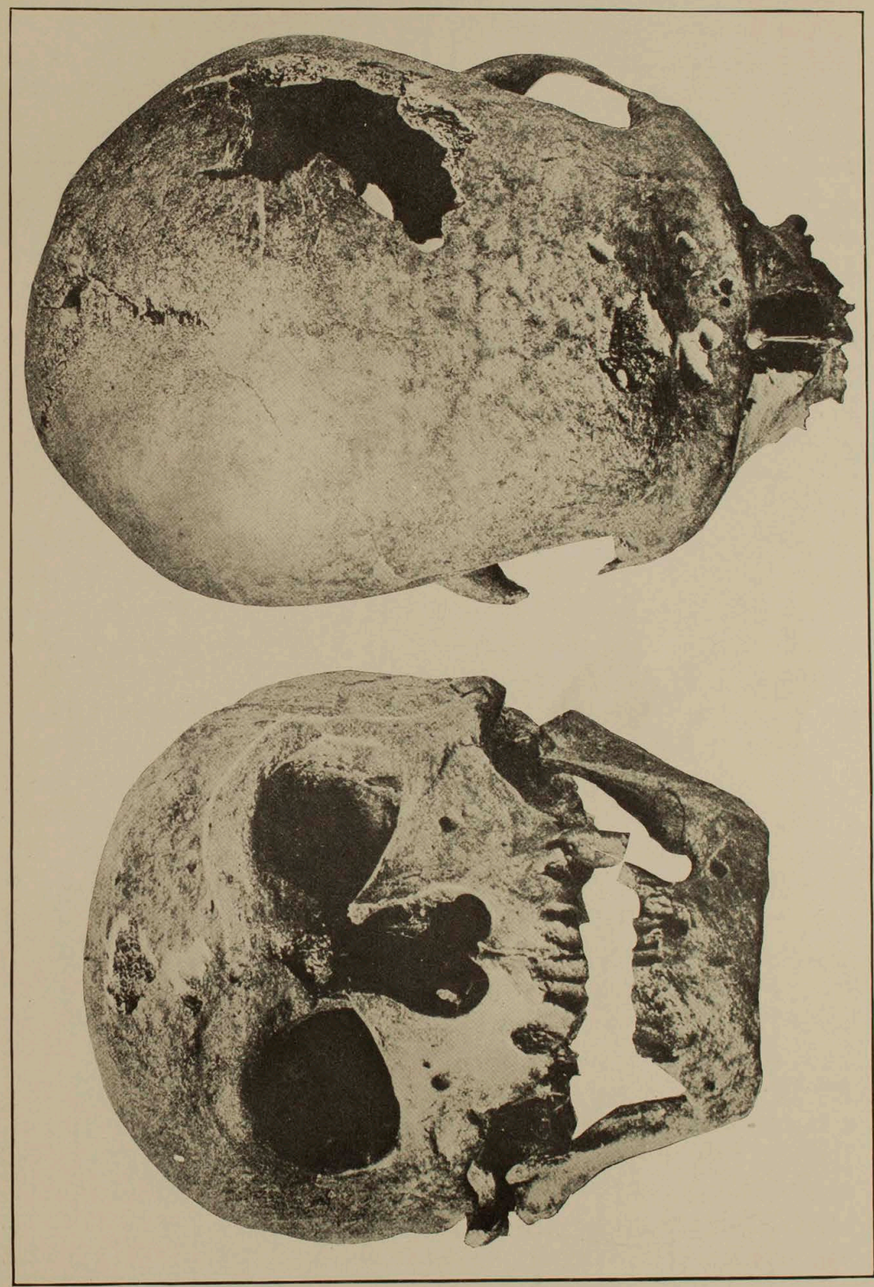
The state of preservation of the specimens is exactly like that of the animal bones recovered from the deposits above the burial fossa. They are ferruginous in color, heavier than any corresponding recent human bones and very perceptibly mineralized.

Due to the kindness of Prof. Boule the writer was enabled in 1912 to see the originals of the Chapelle-aux-Saints skeleton. At that time, however, Prof. Boule's investigations on the specimens were not yet completed, in consequence of which it was not possible to undertake any detailed study on the bones, but even a brief examination was sufficient to impress one deeply, particularly in the case of the skull, with the great scientific value of the remains. They represent unquestionably another precious addition to the rapidly augmenting material evidence of the highly interesting type of ancient man, the *Homo neanderthalensis*.

Since the writer's visit to the Paris Museum, Prof. Boule's reports on the La Chapelle skeleton have been published in full. With these well-illustrated reports as well as a plaster model of the skull, and with what it was feasible to observe on the originals, it is possible to give the following brief notes on these specimens.

The La Chapelle skull, notwithstanding its many peculiarities, is plainly a normal specimen, not affected (except in the dental arches) by any disease or by any premature closure of sutures (pls. 35, 36).

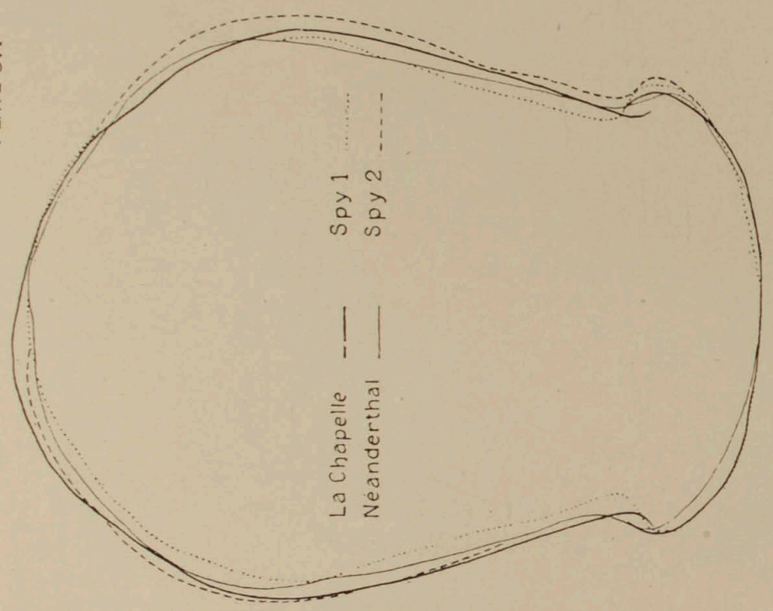
PLATE 36.



THE SKULL OF LA CHAPELLE-AUX-SAINTS IN FRONT AND TOP VIEWS.
(After Boule.)

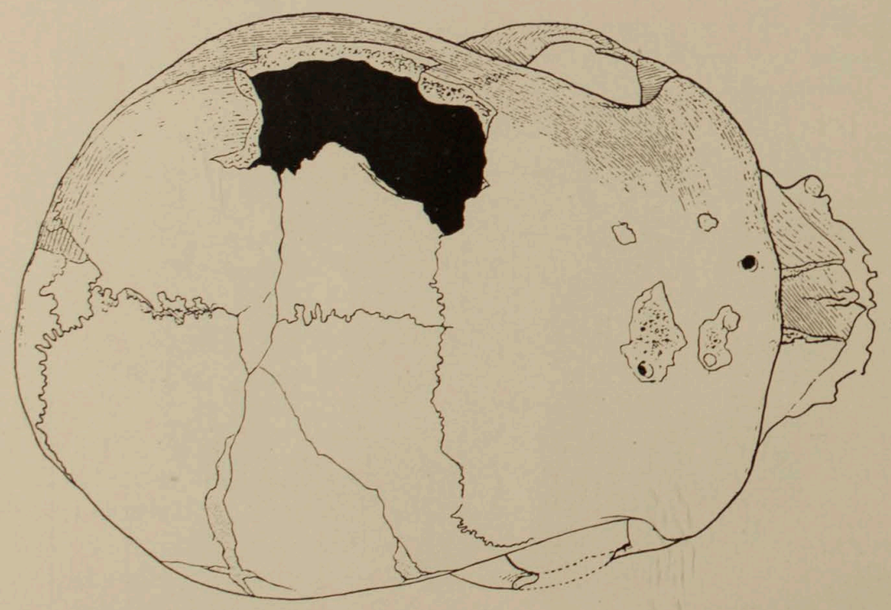
Smithsonian Report, 1913.—Hrdlička.

PLATE 37.



b

b. OUTLINE OF THE VERTICAL PLANE IN THE LA CHAPELLE AND OTHER SKULLS OF THE NEANDERTHAL TYPE. (After Boule.)



a

a. THE SKULL OF LA CHAPELLE-AUX-SAINTS, IN VERTICAL PLANE. (After Boule.)

Smithsonian Report, 1913.—Hrdlička.

The skull is distinctly masculine, and proceeds from an adult of somewhat advanced age.

Its vault is remarkably like that of the Neanderthal cranium, though somewhat larger. There is the same huge, prominent, complete supraorbital arch. The nasal process is equally broad and sloping considerably downward and backward. Due to the pronounced supraorbital arch the upper half of the orbits, as in the Neanderthal skull, has a somewhat forward and downward inclination, wholly unlike that of any man of to-day. The forehead, while low, is somewhat better formed than in the Neanderthal and Spy No. I crania and less sloping. The sagittal region is smooth and oval from side to side. The occiput is broad and shows a fair protrusion but as general in the Neanderthal type of skulls and in harmony with the rest of the vault, it is decidedly low. The outline of the vault when viewed from above is a prolonged ovoid, mildly asymetric in its posterior portion, due to a slightly greater size and protrusion backward of the right side (pl. 37). The mastoids are remarkably moderate for a male skull and one of this size, approaching in this respect the earlier primate form. The zygomae are stout and widely expanded, due to powerful temporal muscles.

The bones of the vault, again, as in the Neanderthal and other crania of this type, are thicker than in the skulls of modern man; nevertheless the capacity of the skull was quite large. Prof. Boule estimates it at from 1,600 to 1,620 c. c. This indicates not necessarily a superior brain, but rather one subserving to largely developed organs and powerful musculature.

Turning to the base of the skull, we find that while the glenoid fossæ, excepting their large size and one or two other peculiarities, are more like those of recent man than those for instance in the Krapina crania, the foramen magnum is of a very large size[1] and is situated, or rather extends farther backward than in man of the present day. There were probably other primitive features of the base, which the damaged parts do not allow to determine with certainty (figs. 10, 11).

The facial parts show malar bones with powerful frontal and zygomatic processes, but rather small and not prominent body. The nasal structures indicate that the nose was quite long and very broad; but the lower borders of the nasal aperture are already fairly sharp, as in more modern crania, and the nasal spine, though bifid, was well developed.

The orbits are not excessively high, but are spacious and deep. The suborbital (canine) fossæ are totally absent, the maxilla showing

[1] Corresponding to a stout spinal cord, which is generally associated with a pronounced development of the motor system and other parts of the body.

in their place even a slight convexity. The lower part of the face was prognathic, though evidently not excessively so. The dental arches regrettably show extensive effects of a suppurative process, as the result of which all but one or two of the teeth in the two jaws have been lost, and the height of the alveolar processes was much reduced by absorption. All that can be determined is that the subnasal portion of the upper jaw was quite high, and that the palate was enormous.

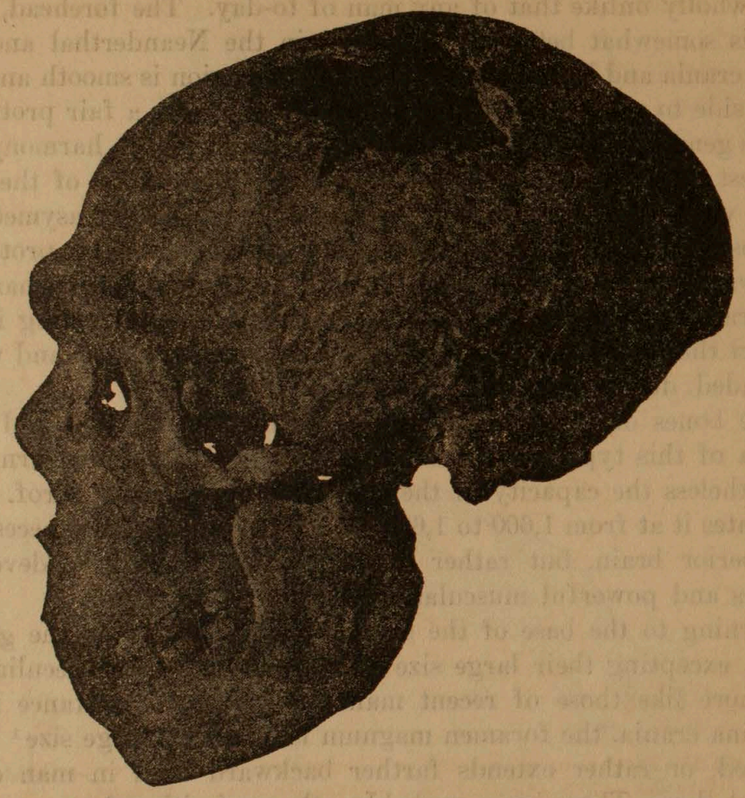


FIG. 10.—SKULL OF THE FOSSIL MAN OF LA CHAPELLE-AUX-SAINTS, AFTER RESTORATION OF THE NASAL BONES AND JAWS. (After Boule; reproduced by MacCurdy, Smithsonian Report for 1909.)

The lower jaw is large, stout, chinless—though not sloping backward at the symphisis, and otherwise primitive. It was doubtless high, but the reduction of the alveolar process through pyorrhœa and absorption does not permit a definite appreciation of this character.

Although only two badly worn premolars remain in the two jaws, it can nevertheless be clearly seen from the size of their roots, from the alveoli and from the size of the dental arches, that the teeth in this skull must have been very large.

The long and other bones of the skeleton are, on the whole, less remarkable than those of the Neanderthal or Spy remains, but the peculiarities and primitive features which they possess are of much the same order. The stature of the Chapelle-aux-Saints man is estimated by Prof. Boule to have been about 1.611 meters (5 ft. 3 in.), which is close to that of the Neanderthal man and the man of Spy. The bones are robust; the extremities of the long bones are large. The radii and ulnæ and especially the tibiæ and fibulæ, are again, as in other skeletons of the Neanderthal type, relatively short. There

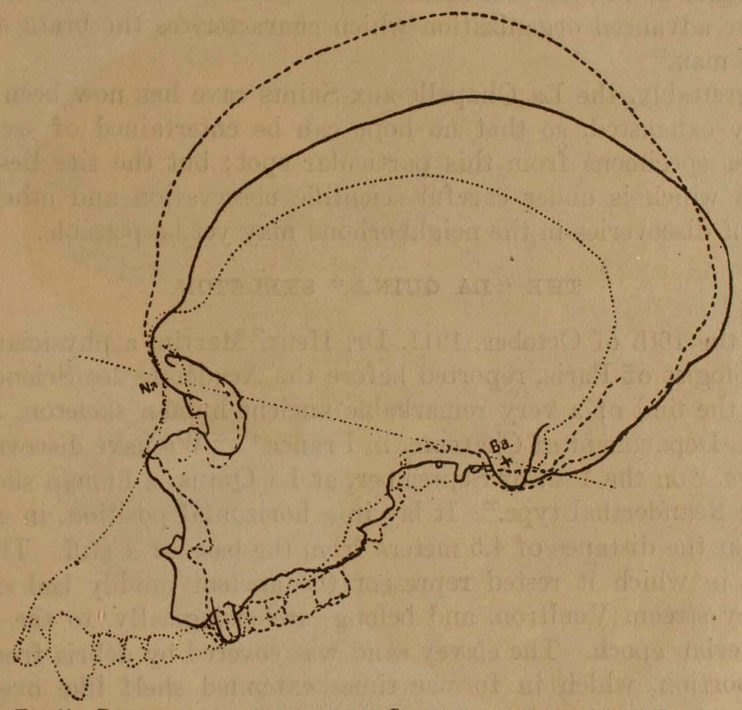


FIG. 11.—PROFILES OF THE CRANIUM OF A CHIMPANZEE, THE CRANIUM OF LA CHAPELLE-AUX-SAINTS, AND THAT OF A MODERN FRENCHMAN SUPERPOSED, AND WITH A COMMON BASI-NASAL LINE EQUAL IN LENGTH FOR EACH. (After Boule; reproduced by MacCurdy, Smithsonian Report for 1909.)

Ba., Basion; Na., Nasion.

is also the pronounced curvature to the radius; and there are other peculiarities about the specimens an enumeration of which in this place is not feasible. Certain of these peculiarities indicate, according to Prof. Boule, that the individual from whom the Chapelle-aux-Saints skeletal remains proceed had, in common with others of the Neanderthal type, not as yet reached a fully erect posture.

The study of the brain of this individual, so far as possible from a cast of the cranial cavity, also shows various features of importance.[1]

[1] Boule, M., and R. Anthony. L'encéphale de l'homme fossile de La Chapelle-aux-Saints. (L'Anthropologie, vol. 22, 1911, pp. 129–196.)

Among the more strictly human characteristics are its large size, normally always a very favorable feature, though not necessarily an index of high intelligence; a predominance in size of the left over the right hemisphere; and certain other anatomical features. The more simian characteristics included especially the general form of the organ, the evident simplicity and coarseness of the convolutions, and the relatively poor development of the frontal parts, which is more pointed forward than obtains in man of to-day. "The brain, on the whole," to quote Prof. Boule, "is already human by the abundance of the cerebral substance; but this substance is still lacking the advanced organization which characterizes the brain of the actual man."

Regrettably, the La Chapelle-aux-Saints cave has now been completely exhausted, so that no hope can be entertained of securing further specimens from this particular spot; but the site lies in a region which is under careful scientific observation and other important discoveries in the neighborhood may yet be possible.

THE "LA QUINA" SKELETON.

On the 16th of October, 1911, Dr. Henri Martin, a physician and archeologist of Paris, reported before the Académie des Sciences of Paris the find of a very remarkable ancient human skeleton, at La Quina, Department of Charente, in France.[1] "We have discovered," he says, "on the 18th of September, at La Quina, a human skeleton of the Neanderthal type." It lay in a horizontal position, in clayey sand, at the distance of 4.5 meters from the base of a cliff. The deposits in which it rested represent the ancient muddy bed of the near-by stream Voultron, and belong, archæologically, to the lower Mousterian epoch. The clayey sand was covered by débris from the cliff portion, which in former times extended shelf like over the stream.

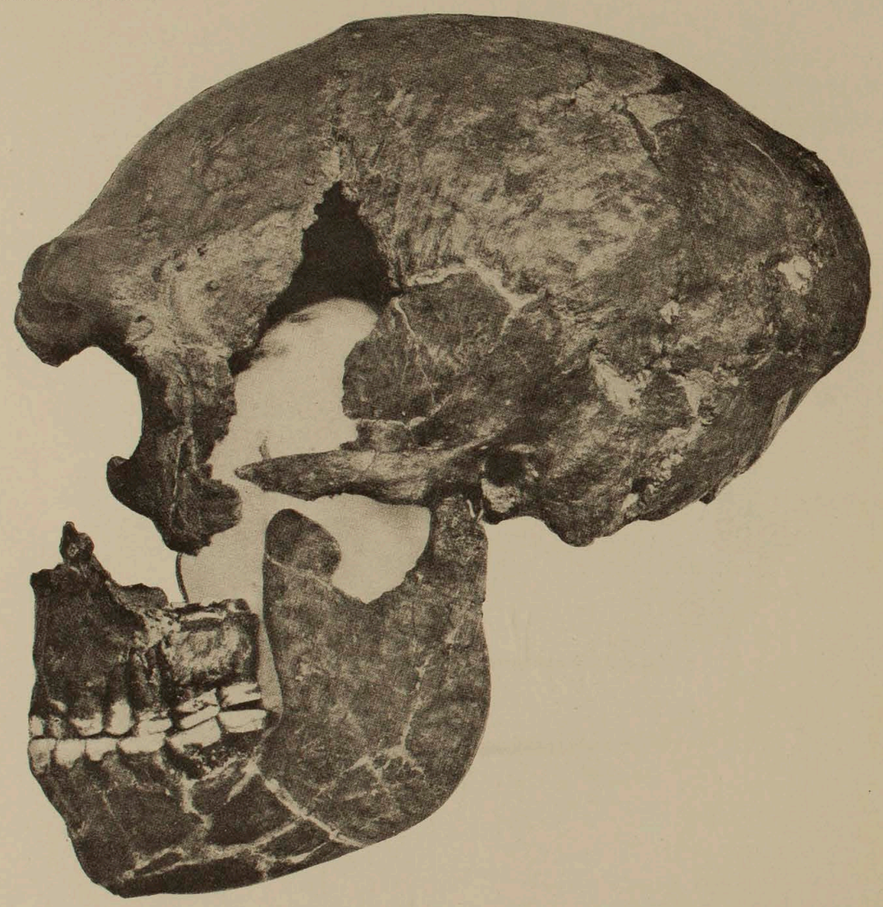
The skeleton lay 80 cm. (2.6 ft.) deep in the sand, and was not surrounded by any objects which would indicate an intentional burial. Its location and position seemed to show that the body was deposited where it lay accidentally. The clayey sand contained a few disseminated worked stones and a few bones that have been utilized by man, but showed none of the handsome pieces which characterized the superior Mousterian epoch. The age of the skeleton is, in all probability, referable to the earliest part of the middle Quaternary.

The remains have suffered from prolonged submersion and pressure, as a result of which the cranial bones were disjointed and in part broken; but from the first instant it could readily be seen that

[1] Martin, Henri. Sur un squelette humain de l'époque moustérienne trouvé en Charente. (Comptes Rendus, tome 153, 1911, p. 728.)

THE LA QUINA SKULL AND PARTS OF THE SKELETON STILL IN THE MATRIX.
(After H. Martin.)

Smithsonian Report, 1913.—Hrdlička. PLATE 39.



THE LA QUINA SKULL, PARTLY RECONSTRUCTED.
(After H. Martin.)

the cranium presented in a high degree certain primitive characteristics in which it approaches those of the Neanderthal type.

A little later in the year Dr. Martin made a somewhat more extensive report on the find before the Prehistoric Society of France,[1] and in 1912 he published four other accounts relating to the discovery.[2] From these publications it appears that archeological explorations at La Quina by Dr. Martin and others had been carried on intermittently for seven years before the human skeleton came to light, yielding many examples of paleolithic stone industries referable in the main to the upper or younger division of the Mousterian epoch. In addition a number of human teeth and various fragments of human bones, belonging to the upper Mousterian, were encountered during this time, but none, barring perhaps a larger portion of one lower jaw, are of special importance.[3]

The sandy layer which contained the La Quina skeleton yielded some worked stones representing lance points, knives, and scrapers, but all of inferior workmanship. Evidence was also found in traces of fire and calcined bones, that man of the period represented by the skeleton lived or took refuge in the caverns or holes of the cliff above. The animals on which the La Quina man lived were the reindeer, bison, horse, and rarely also the mammoth. The total Mousterian deposits at La Quina indicate a long duration of the epoch, and one during which man advanced considerably in the way of manufacture of his stone utensils.

The bones of the skeleton were taken to Paris, partly still in the sediments with which they were surrounded, and were then most carefully worked out from the matrix (pl. 38). The different parts of the skull, it was found, besides being disjointed, were forced together so as to overlap, while the facial parts were broken and to a large extent deficient. With what was left of the jaws were 14 of the teeth.

The remains were seen at first sight to present a number of important primitive characteristics. The frontal bone showed a very pronounced supraorbital arch, with low and sloping forehead; the vault, it could readily be determined, had been low; the temporal fossæ were spacious, for the accommodation of powerful temporal muscles;

[1] Martin, Henri. Presentation d'un crâne humain trouvé avec le squelette a la base du Moustérien de La Quina (Charente). (Bulletin de la Société Préhistorique Française, Séance du 26 Oct., 1911, pp. 1–12, 3 pls.)

[2] A propos de la découverte de l'homme fossile de La Quina. (Annales de la Faculté des Lettres de Bordeaux, etc., 4th series, vol. 14, 1912, pp. 61–64.) Le Crâne de l'homme fossile Moustérien de La Quina. (C. R. A. F. A. S., 1912, pp. 537–538.) L'homme fossile Moustérien de La Quina (Bull. Soc. Préhistorique Française, 1912, pp. 1–36, 4 pls.), and Position stratigraphique des Ossements humains recueillis dans le Moustérien de La Quina de 1908 à 1912. (Bull. Soc. Préhist. Française, 1912, pp. 1–8, 1 pl.)

[3] Pictured in the publication last named in footnote 2.

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the jaws, particularly the mandible, were heavy; and the teeth were large in size, besides showing other remarkable features.

In June, 1912, Dr. Martin kindly showed the precious originals to the writer. At that time the skull was already fairly well restored, and impressed one as a typical, though not very massive, representative of the Neanderthal type of crania (pl. 39). It presents the same extraordinary supraorbital arch, a similar low forehead, similarly low vault, and similar ovoid outline when looked at from above, as the Neanderthal, Spy, Gibraltar, and other skulls of the group; but the occiput is rather more protruding. The lower jaw is stout and evidently possessed little, if any, chin prominence; the teeth, though considerably worn off, are very large. There is nothing pathological about the specimen or other parts of the skeleton. The individual from whom it proceeds was an adult of perhaps 45 years of age, and, in the opinion of Dr. Martin, supported by the relative gracility of the bones, it was a female. The skull, as well as the other bones, show advanced state of mineralization. The color of the skull is ocher to brownish yellow, with areas or ramifications of darker brown. As to the teeth, the dentine parts are darkened, but the enamel is well preserved and white. The other bones of the skeleton are yellowish gray.

The long and other bones, so far as saved, indicate an individual of moderate stature and good, but not excessive, musculature. As to the detailed characteristics of the bones as well those of the skull, it will be necessary to await the complete report by Dr. Martin.

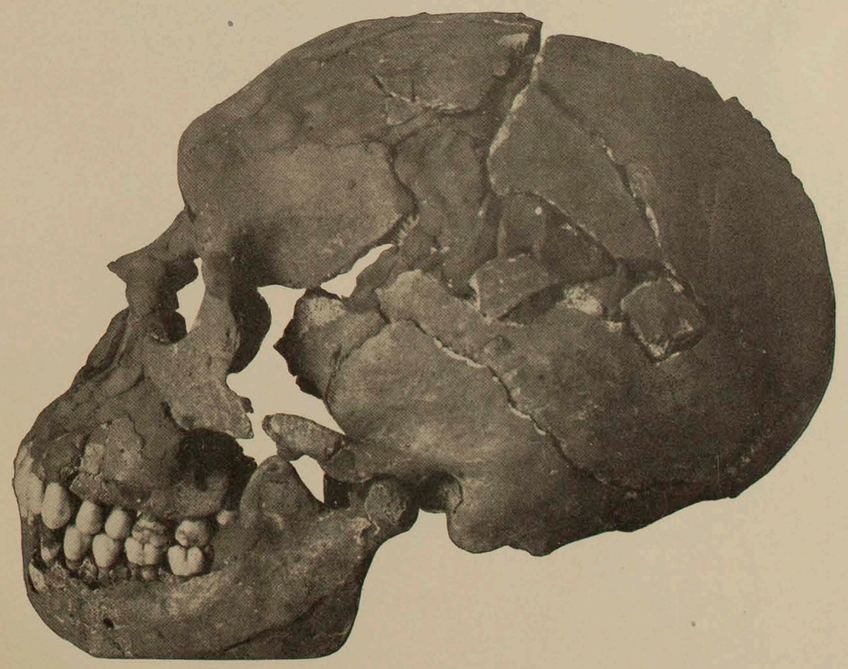
An ingenious effort at a reconstruction of the head and neck of the La Quina woman by Dr. Martin will be found in the Bulletin de la Société Préhistorique Française, of 1913.[1]

THE MOUSTIER MAN.

Still another highly interesting and scientifically valuable skeleton of early man, recently discovered, is that of the so-called "*Homo mousteriensis* Hauseri." The skeleton is preserved in the Museum für Völkerkunde at Berlin, where it was seen by the writer. It was discovered in March 1908, by O. Hauser, during archeological excavation in what is known as "the lower Moustier cave," or "paleolithic station number 44," at Le Moustier, in the valley of the Vezère, Department of Dordogne, France, and was eventually purchased from Herr Hauser for the Berlin Museum.

The cave in question (fig. 12), or more properly rock shelter, when excavated gave numerous evidences of man's occupation, but no human bones. The skeleton under consideration was discovered in the terrace in front of the cave, almost vertically below its entrance. It

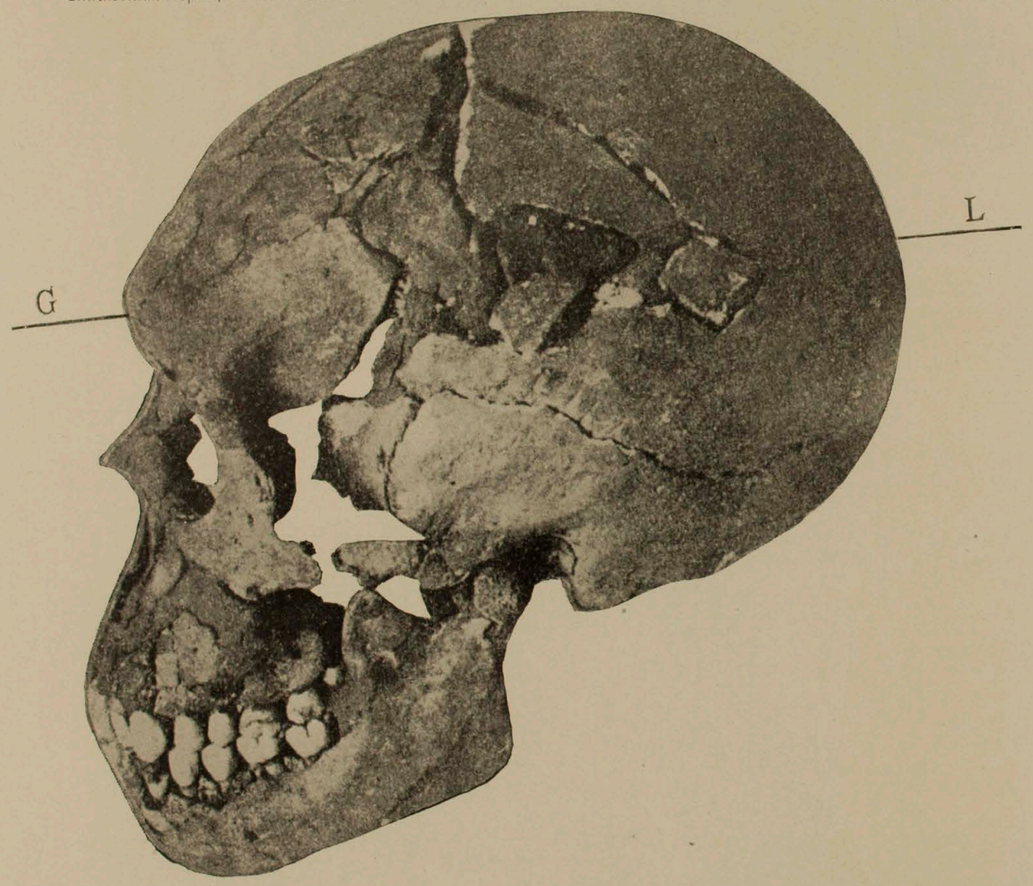
[1] Séance du 27 Février, 1913.



HOMO MOUSTERIENSIS, FROM THE CAVERN OF LE MOUSTIER (DORDOGNE).

(After MacCurdy, from the Smithsonian Report for 1909.)

Smithsonian Report, 1913.—Hrdlička. PLATE 41.



THE SKULL OF HOMO MOUSTERIENSIS HOUSERI. SIDE VIEW.

lay about 3 feet deep and no disturbance in the superimposed deposits was noticeable.

The human bones were uncovered with great care in the presence of responsible witnesses, then covered again with earth and left in situ for several months, though shown during this time to a number of visitors. In August they were exposed for Virchow, v. d. Steinen, Klaatsch, and other scientific men, and finally, two days afterwards, in the presence of Prof. Klaatsch, they were gathered from the deposits.

A somewhat picturesque account of the discovery by Hauser will be found in the 1909 volume of the Archiv für Anthropologie.[1] The skeleton, it appears, lay on its side in a natural position, with the

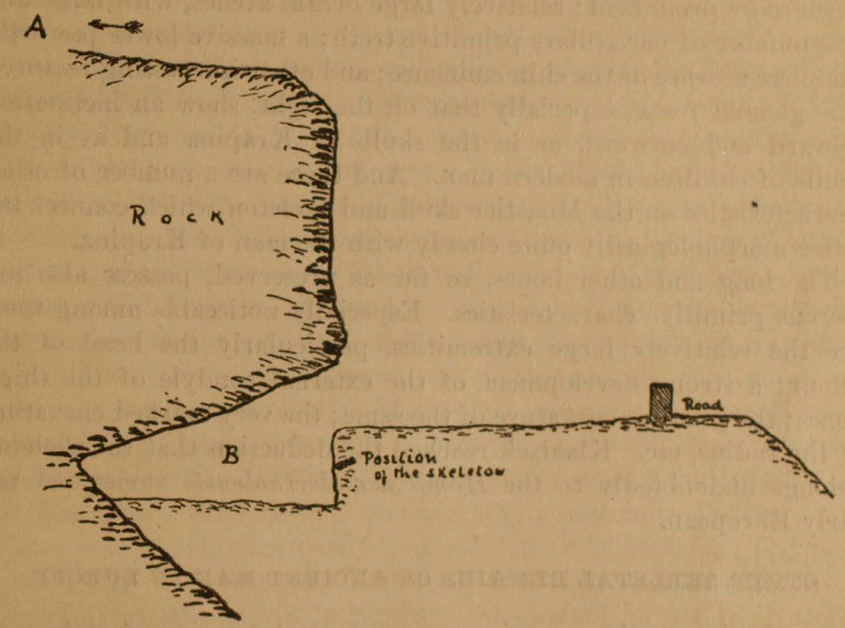


FIG. 12.—THE UPPER (A) AND LOWER (B) LE MOUSTIER CAVES AND THE POSITION OF THE SKELETON OF HOMO MOUSTERIENSIS. (After Klaatsch & Hauser.)

right hand under the occiput, the left extended along the body. About the body and among the bones were found seventy-four worked flints, ten of which were of a well-defined form. On the skull rested a charred bone of a *Bos primigenius*, and in the neighborhood of the thorax lay a tooth of the same animal. Besides this, 45 other fragments of animal bones were gathered in a close vicinity to the human remains.

[1] Klaatsch, A., and O. Hauser. Homo mousteriensis Hauseri. Ein altdiluvialer Skelettfund im Departement Dordogne und seine Zugehörigkeit zum Neandertaltypus. (Archiv f. Anthropologie, N. F., vol. 7, 1909.)

The examination of the human bones was begun on the spot by Prof. Klaatsch, who eventually reached the following conclusions:

The skeleton belongs to an adolescent of perhaps 16 years of age and probably of the male sex. The height of the boy, as estimated from the long bones, was probably 1.45 to 1.50 meters (4 feet 9 inches to 4 feet 11 inches).

The skull (pls. 40, 41) notwithstanding the youth of the subject, shows a number of characteristics which are peculiar to the Neanderthal group. While of a good size, with only moderately thick bones of the vault and the latter of a fair height, it shows nevertheless a rather low and sloping forehead; a well-marked complete supraorbital arch or torus, which later in life would doubtless have become much more prominent; relatively large dental arches, with large and in a number of particulars primitive teeth; a massive lower jaw with complete absence of the chin eminence; and other interesting features. The glenoid fossæ, especially that on the right, show an inclination upward and outward, as in the skulls of Krapina and as in the skulls of children in modern man. And there are a number of other characteristics on the Moustier skull and skeleton which connect the latter morphologically quite closely with the man of Krapina.

The long and other bones, so far as preserved, possess also numerous primitive characteristics. Especially noticeable among these are the relatively large extremities, particularly the head of the femur; a strong development of the external condyle of the thigh bones; the peculiar curvature of the same; the very marked curvature of the radius, etc. Klaatsch reached the deduction that the skeleton belongs undoubtedly to the *Homo neanderthalensis* variety of the early European.

OTHER SKELETAL REMAINS OF ANCIENT MAN IN EUROPE.

In addition to the more important skeletal remains of early man dealt with in the preceding pages, there exist a considerable number of specimens which, because of their isolated or defective nature, are of less value to science, or which have not as yet been properly studied and determined, or which, finally, retain some elements of uncertainty as to their true position in human chronology. And besides these there is a large additional series of skeletal remains, including the latest paleolithic and the neolithic remains, which, while still ancient, are nevertheless relatively near to man of the present date.

Among the earlier isolated or defective specimens may be mentioned first of all the two teeth of Taubach. One of these, a molar of the first dentition, was found in the old Quaternary deposits at

Taubach near Weimar, Germany, in 1892, by A. Weiss. The crown of this tooth shows considerable wear and this, with other characteristics of the specimen, created at first an impression that the tooth was perhaps not human. Later, however, the tooth was accepted as proceeding from a human child. Meanwhile one of the laborers at Taubach discovered in equally old deposits a first permanent left lower molar about the human nature of which there can be no question, and this tooth also shows various primitive features. Both these finds have been reported upon and the specimens described by Nehring.[1] The permanent molar is preserved in the museum in Jena.

Other specimens belonging to this category are the more or less defective lower jaws of La Naulette, Malarnaud, and Šipka. The La Naulette jaw was found in 1866 by Dupont in a cave at La Naulette, Belgium, together with an ulna and a few other fragments of human bones. The find was reported and the bones described by Dupont in the Bulletin de l'Académie Royale Belge, second series, volume 12, 1866, and by Topinard in the Révue d'Anthropologie of the same year. The original specimen is preserved in the Musée Royal d'Histoire Naturelle, Brussels. It is evidently a portion of the lower jaw of a subadult female. It lacks all chin prominence and shows primitive features of the alveoli and hence teeth, such as a broad root of the canine with the central groove on each side, and the very perceptibly increasing size of the sockets of the molars from before backwards.

The lower jaw of Malarnaud was discovered in 1889 in a small side chamber of the cave of Malarnaud, near the village of Montseron, Arize, France. It lay 2 meters (about 7 feet) deep beneath a layer of stalagmite, in a mass consisting of a great quantity of bones of Quaternary animals and reddish clay. The bone is that of an adolescent, the third molars being still in their sockets. The teeth are missing, with the exception of the first right molar. The jaw is not of great size and is rather low but stout. As the La Naulette specimen, it lacks the chin prominence such as characterizes the lower jaw of modern man.[2]

The Šipka specimen is a fragment of the lower jaw of a child, probably between the eighth and tenth year of age. It was found in 1880 in the Šipka cave, near Štramberk, Moravia, by Dr. Karel J. Maška, the deserving Moravian explorer. It shows six teeth—three incisors, the right canine, and the two right premolars, the

[1] Nehring, A. Über einen fossilen Menschenzahn aus dem Diluvium von Taubach bei Weimar. (Verh. Berl. G. Anthr., etc., Zeit. Ethn., 1895, pp. 338–340, 425–433.) Same author, Uber einen Menschlichen Molar aus dem Diluvium von Taubach bei Weimar. (Ibid., pp. 573–577.) See also Adloff, Das Gebiss des Menschen und der Anthropomorphen., Berlin, 1908; Schmidt, R. R., Die diluviale Vorzeit Deutschlands, Stuttgart, 1912; and Festschrift Anthropologische Versammlung Weimar, 1912.

[2] For original descriptions of the find, see Filhol, H.—Bull. de la Soc. Philomath. de Paris, 1889, and Congrès Anthrop. Préhist., 1889, p. 417.

three last named not yet erupted. The bone is very stout and shows other primitive features, but the chin was already slightly developed. The original of the Šipka jaw is still in the care of Prof. Maška at Telč, Moravia, where it was seen by the writer.[1]

Among the specimens which while indubitably ancient have not as yet been completely or finally described, should be mentioned, in the first place the parts of the several skeletons discovered between 1909 and 1912 by Capitan and Peyrony, in the late Mousterian archeological deposits of La Ferrassie, and the child's skull found by the same explorers in 1909 in the cave of Pech de l'Aze, near Sarlat (Dordogne), France. The writer has seen these specimens, which are preserved and are being restored in the Museum d'Histoire Naturelle, Paris; they are in the care of Prof. Boule, who will eventually describe them. Certain observations on some parts of these skeletons have already been included in Prof. Boule's reports on the Chapelle-aux-Saints' skeleton. He holds that the remains belong to the *Homo Neanderthalensis*.[2]

Among the ancient, but less definitely determined skeletal remains, and among those belonging to the younger paleolithic (Late Quaternary) period, there may be mentioned especially the Ochoz,[3] Brux (Most),[4] Brno (Brünn) No. 1,[5] Canstadt,[4] Combe-Capelle,[6] Eguisheim,[7] Galley Hill,[8] and possibly the Ipswich,[9] skulls and skeletons. For the often not fully satisfactory details concerning these specimens the reader must be referred to the original publications.

Of especial importance, however, is the magnificent collection of ancient skeletal remains discovered at Předmost, Moravia, by Prof. K. J. Maška. This splendid material, which consists of 14 human

[1] For detailed description of the Šipka and the jaw, with the earlier literature of the find, see Maška, Karel, J.—Der diluviale Mensch in Mähren, 8°. Neutitschein, 1886.

[2] For first reports concerning these finds, see Boule, M.—Nouvelles entrées dans les collections de Paléontologie du Muséum. (L'Anthropologie, vol. 22, 1911, pp. 112–113.) Capitan, L., and Peyrony—Station préhistorique de la Ferrassie. (Revue anthropologique, vol. 22, 1912, pp. 29–99.) Capitan, L. & Peyrony. Trois nouveaux squelettes humains fossiles. (Revue anthropologique, Nov., 1912, pp. 439–440); and Obermaier, H.—Der Mensch der Vorzeit, vol. 1, 1912, pp. 144–145, 339, 436.

[3] Rzehak, A. Verhandlungen des naturforschenden Vereins, Brünn, vol. 44, 1905; and Zeitschrift des Mährischen Landesmuseums, vol. 9, Brünn, 1909, pp. 277–313.

[4] Schwalbe, G. Studien zur Vorgeschichte des Menschen. Zeitschrift für Morphologie und Anthropologie, Sonderheft, 1906, with further biography.

[5] Makowsky, A. Der Mensch der Diluvialzeit Mährens. Brünn, 1899; Obermaier, H.—Der Mensch der Vorzeit, 1912, pp. 298–352.

[6] "Homo Aurignacensis Hauseri"; Klaatsch, H., and O. Hauser.—Prähist. Zeitschr., 1910; and Klaatsch, H.—Die Aurignacrasse und ihre Stellung im Stammbaum der Menschheit. (Zeitschr. Ethnol., 1910.)

[7] Broca, P. Fragments de crâne humaine d'Eguisheim. (Bull. Soc. D'Anthrop, Paris, 2d ser., Paris. 1867, pp. 129–131): Schwalbe, G.—Der Schädel von Egisheim Beiträge zur Anthropologie Elsass Lothringes Heft 3, Strassburg, 1902.

[8] Newton, E. T. Quarterly Journal of the Geological Society, August, 1895; also Munro, R.—Paleolithic man, etc., Addenburg, 1912, pp. 109–115; Keith, A.—Ancient types of man, 1911; also Duckworth, W. J. H.—Prehistoric man, Cambridge, 1912.

[9] Being determined and described by Prof. Arthur Keith.

skeletons, some of them almost complete, with additional skeletal parts from six other bodies, is now being studied by Prof. J. Matiegka, the director of the Anthropologický Ústav, of Prague. The writer has seen this collection on two occasions and he regards it as by far the most important assemblage of material from the transitional period between earlier and the latest paleolithic forms. It represents in a measure the much searched-for bridge between the Neanderthal and recent man. Archeologically, these valuable skeletons belong to the earlier Solutrean or the Aurignacean.

Besides the above described or enumerated specimens, there are many others scattered over the museums of Europe, for which great or less antiquity has been at some time, or is still being claimed. In many of these instances the student finds that the evidence adduced and the testimony of the skeletal parts themselves speak rather against any great age, or leave the subject in serious doubt. It would seem best for the progress of science to eliminate all such specimens, with perhaps some of those mentioned above, from consideration, unless or until new and ample evidence be found to convince us that they really deserve place in the range of the precious authentic documents that represent the earlier phases of man's natural history.

The gradually accumulating finds which throw light on the physical past of man, have naturally stimulated further exploration in the same lines; and the various failures and uncertainties connected with some of the finds in the past have impressed all investigators in the field with the necessity of the most careful and properly controlled procedure. Besides men of science, the educated public, engineers controlling public works, and even many among the workmen in Europe have been impressed by these remarkable discoveries, and in hundreds of instances are doubtless watching for new treasures. Under these conditions we are justified in hoping that from time to time we shall receive additions to the precious material already in our hands; that these additions will fill the existing vacua, and gradually extend farther back to the more strictly intermediary forms between man and his ancestral stock, and perhaps eventually even to the source of these link-forms themselves, to the peculiar morphologically unstable family of the anthropogenous primates.

While the anthropologist is thus painfully and slowly reconstructing the past physical history of man, he is also with every new fact adding another imperishable block to the foundation upon which will stand not only the knowledge of the future in regard to man himself, but also the laws of his further physical development, and radically even those of his beliefs and his moral behavior. This is a part of the service of anthropology to humanity.

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